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A Continuing Bibliography with Indexes

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AEROSPACE MEDICINE AND BIOLOGY

A CONTINUING BIBLIOGRAPHY WITH INDEXES

(Supplement 337)

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced in May 1990 in

- *Scientific and Technical Aerospace Reports (STAR)*
- *International Aerospace Abstracts (IAA).*

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INTRODUCTION

This Supplement to *Aerospace Medicine and Biology* lists 400 reports, articles and other documents announced during May 1990 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA).* The first issue of the bibliography was published in July 1964.

In its subject coverage, *Aerospace Medicine and Biology* concentrates on the biological, physiological, psychological, and environmental effects to which man is subjected during and following simulated or actual flight in the Earth's atmosphere or in interplanetary space. References describing similar effects on biological organisms of lower order are also included. Such related topics as sanitary problems, pharmacology, toxicology, safety and survival, life support systems, exobiology, and personnel factors receive appropriate attention. In general, emphasis is placed on applied research, but references to fundamental studies and theoretical principles related to experimental development also qualify for inclusion.

Each entry in the bibliography consists of a bibliographic citation accompanied in most cases by an abstract. The listing of the entries is arranged by *STAR* categories 51 through 55, the Life Sciences division. The citations, and abstracts when available, are reproduced exactly as they appeared originally in *IAA* or *STAR,* including the original accession numbers from the respective announcement journals. The *IAA* items will precede the *STAR* items within each category.

Seven indexes — subject, personal author, corporate source, foreign technology, contract, report number, and accession number — are included.

An annual index will be prepared at the end of the calendar year covering all documents listed in the 1990 Supplements.

Information on the availability of cited publications including addresses of organizations and NTIS price schedules is located at the back of this bibliography.

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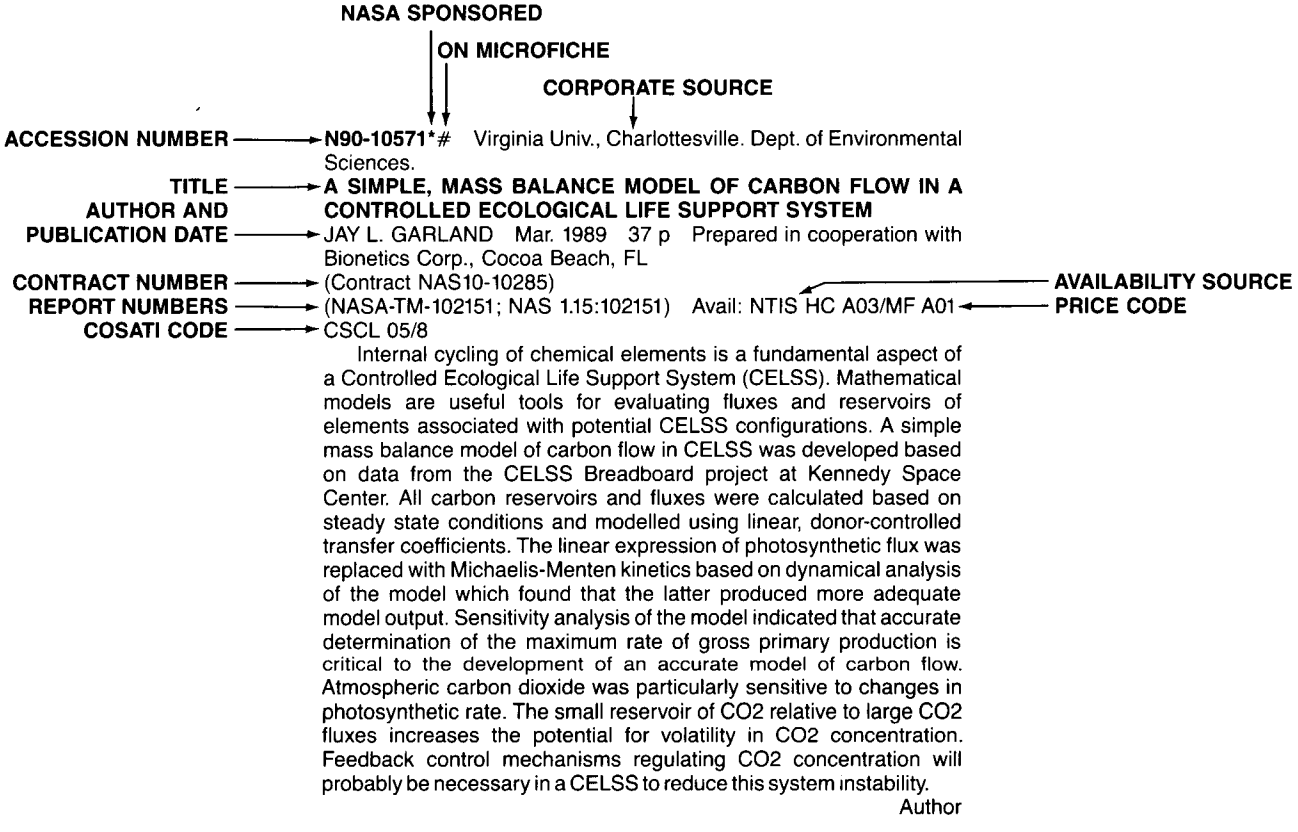
TYPICAL REPORT CITATION AND ABSTRACT



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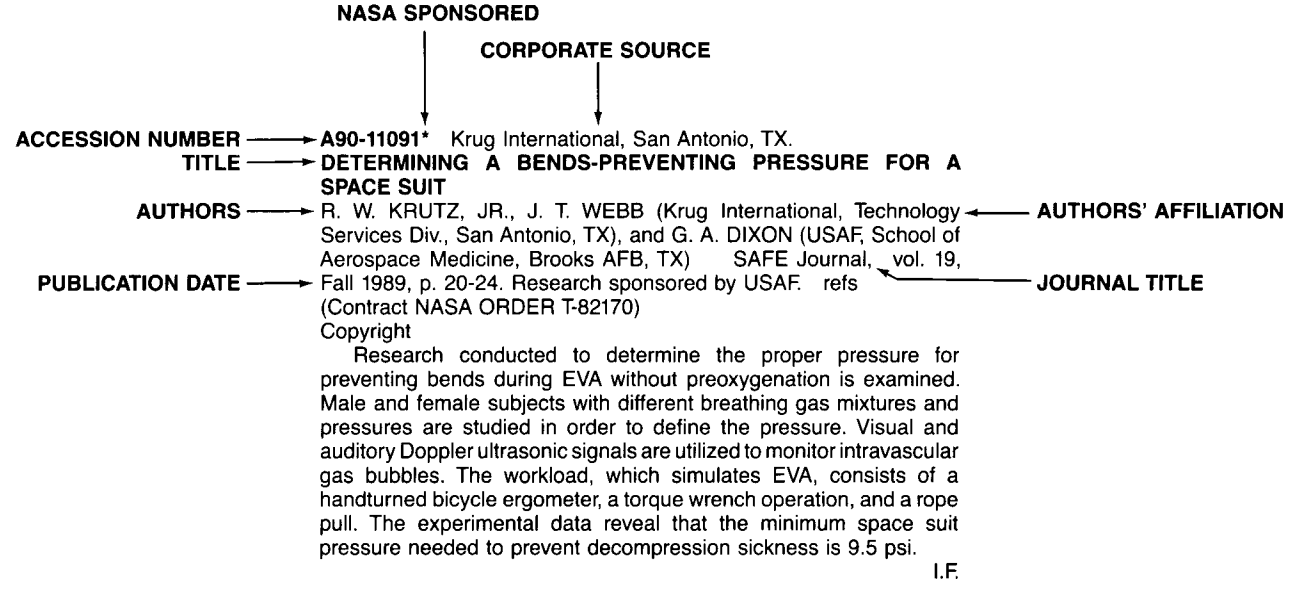

AEROSPACE MEDICINE AND BIOLOGY

A Continuing Bibliography (Suppl. 337)

JUNE 1990

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LIFE SCIENCES (GENERAL)

A90-24220
REGULATION OF HEMOPOIESIS IN AN ORGANISM EXPOSED TO EXTREME FACTORS [REGULIATSIIA GEMOPOEZA PRI VOZDEISTVII NA ORGANIZM EKSTREMAL'NYKH FAKTOROV]
ANATOLII P. IASTREBOV, BORIS G. IUSHKOV, and VLADIMIR N. BOL'SHAKOV Sverdlovsk, UrO AN SSSR, 1988, 153 p. In Russian. refs
Copyright

Mechanisms responsible for the regulation of hemopoiesis under normal conditions and under conditions of stress due to exposure to extreme environmental conditions (such as high altitude, high- and low-temperatures, or radiation) are discussed with particular consideration given to the role of immunological, hormonal, neural, and metabolic mechanisms. New findings are presented on the participation of glycosaminoglycanes in the regulation of hemopoiesis under extreme conditions. I.S.

A90-24395* Texas Univ., Houston.
ATROPHY OF THE SOLEUS MUSCLE BY HINDLIMB UNWEIGHTING
DONALD B. THOMASON and FRANK W. BOOTH (Texas, University, Houston) Journal of Applied Physiology (ISSN 0161-7567), vol. 68, Jan. 1990, p. 1-12. refs
(Contract NAG2-239)
Copyright

This paper reviews data derived from the animal hindlimb unweighting model. The review presents the following information about the unweighted soleus muscle: electromyogram activity, the amount and type of protein lost, capillarization, oxidative capacity, glycolytic enzyme activities, fiber cross section, contractile properties, glucose uptake, sensitivity to insulin, the rates of protein synthesis and degradation, the glucocorticoid receptor numbers, the responses of specific mRNAs, and changes in metabolic concentrations. Data of all these studies show that the stress response of the animal to hindlimb suspension is transient and minimal in magnitude (though somewhat variable) and that, after one week of unweighting, the animal exhibits no chronic signs of stress. I.S.

A90-24396* North Carolina Univ., Wilmington.
BONE GROWTH AND CALCIUM BALANCE DURING SIMULATED WEIGHTLESSNESS IN THE RAT
ROBERT D. ROER and RICHARD M. DILLAMAN (North Carolina, University, Wilmington) Journal of Applied Physiology (ISSN 0161-7567), vol. 68, Jan. 1990, p. 13-20. refs
(Contract NAG2-391)
Copyright

Rats, age 28 days, experiencing tail suspension in modified metabolic cages for 1, 2, and 3 wk were compared with littermate controls. Food and water consumption, urinary and fecal Ca excretion, and serum Ca were measured; hearts, fore- and hindlimb bones, skulls, and mandibles were removed for determination of wet, dry, and ash weights and Ca concentration and for histological examination. Weight gain and Ca intake and excretion were the same for both groups; both displayed net Ca gain. Suspended rats had significantly lower wet, dry, and ash weights of femora and tibiae. Dry weights of the humeri and radii/ulnae were moderately higher, and the skull and mandible dry and ash weights were significantly higher in suspended than in control rats. Cortical thickness of the femur, but not humerus, was less in suspended rats. The data are consistent with the hypothesis that bone growth is influenced by the cardiovascular changes associated with tail suspension. Author

A90-24397
SKELETAL MUSCLE ADAPTATION IN RATS FLOWN ON COSMOS 1667
D. DESPLANCHES, M. H. MAYET, E. I. IL'INA-KAKUEVA, B. SEMPORE, and R. FLANDROIS (Lyon I, Universite, France; Institut Mediko-Biologicheskikh Problem, Moscow, USSR) Journal of Applied Physiology (ISSN 0161-7567), vol. 68, Jan. 1990, p. 48-52. Research supported by CNES. refs
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Seven male Wistar rats were subjected to seven days of weightlessness on the Soviet biosatellite Cosmos 1667. Muscle histomorphometry and biochemical analyses were performed on the soleus (SOL) and extensor digitorum longus (EDL) of flight rats (group F) and compared with data from three groups of terrestrial controls: one subjected to conditions similar to group F in space except for the state of weightlessness (group S) and the others living free in a vivarium (V1, V2). Relative to group V2 (its age and weight-matched control group), group F showed a greater decrease of muscle mass in SOL (23 percent) than in EDL (11 percent). In SOL, a decrease in the percentage of type I fibers was counterbalanced by a simultaneous increase in type IIa fibers. The cross-sectional area of type I fiber was reduced by 24 percent. No statistically significant difference in capillarization and enzymatic activities was observed between the groups. In EDL a reduction in type I fiber distribution and 3-hydroxyacyl-CoA-dehydrogenase activity (27 percent) occurred after the flight. Author

A90-24398
CONTRACTILE PROPERTIES OF RAT SOLEUS MUSCLE AFTER 15 DAYS OF HINDLIMB SUSPENSION
L. STEVENS, Y. MOUNIER, X. HOLY, and M. FALEMPIN (Lille I, Universite, Villeneuve d'Ascq, France) Journal of Applied Physiology (ISSN 0161-7567), vol. 68, Jan. 1990, p. 334-340. Research supported by CNES. refs
Copyright

The properties of the contractile elements interacting to develop force in atrophied rat soleus muscle were studied by using single skinned fibers, which permitted direct access to the contractile apparatus. Muscle atrophy was induced by 15 days of hindlimb suspension. Suspension resulted in a decrease of maximal tension relative to an important decline in fiber diameter. Ca affinity of the contractile proteins was not changed insofar as the tension-pCa relationship was not shifted along the pCa axis. However, after hindlimb suspension, the value of the Hill coefficient from the tension-pCa curve was found to be higher, a higher Ca threshold for activitation was reported, and a significant increase in contraction kinetics was described. All these results suggested that, after suspension, the mechanical properties of the slow-twitch

soleus appeared to resemble more closely those of a fast-twitch muscle. The results were in complete agreement with published histochemical data. Author

A90-24399* Arizona Univ., Tucson.
EFFECT OF HINDLIMB SUSPENSION ON CARDIOVASCULAR RESPONSES TO SYMPATHOMIMETICS AND LOWER BODY NEGATIVE PRESSURE
J. MICHAEL OVERTON and CHARLES M. TIPTON (Arizona, University, Tucson) Journal of Applied Physiology (ISSN 0161-7567), vol. 68, Jan. 1990, p. 355-362. refs
(Contract NAG2-392; NIH-HL-33782-02)
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To determine whether hindlimb suspension is associated with the development of cardiovascular deconditioning, male rats were studied before and after undergoing one of three treatment conditions for 9 days: (1) cage control (n = 15, CON), (2) horizontal suspension (n = 15, HOZ), and (3) head-down suspension (n = 18, HDS). Testing included lower body negative pressure administered during chloralose-urethan anesthesia and graded doses of sympathomimetic agents (norepinephrine, phenylephrine, and tyramine) administered to conscious unrestrained animals. Both HDS and HOZ were associated with a small decrease in the hypotensive response to lower body negative pressure. The HOZ group, but not the HDS group, exhibited augmented reflex tachycardia. Furthermore, both HDS and HOZ groups manifested reduced pressor responses to phenylephrine after treatment. These reductions were associated with significantly attenuated increases in mesenteric vascular resistance. However, baroreflex control of heart rate was not altered by the treatment conditions. Collectively, these results indicate that 9 days of HDS in rats does not elicit hemodynamic response patterns generally associated with cardiovascular deconditioning induced by hypogravic conditions. Author

A90-24746
BLOOD FLOW AND OXYGEN SATURATION IN THE BRAIN OF INTACT AND ANESTHETIZED RABBITS UNDER ANTIORTHOSTATIC INFLUENCE [KROVOOBRASHCHENIE I NAPRIAZHENIE KISLORODA V GOLOVNOM MOZGU BODRSTVUIUSHCHIKH I NARKOTIZIROVANNYKH KROLIKOV PRI ANTIORTOSTATICHESKOM VOZDEISTVII]
A. I. BEKETOV (Krymskii Meditsinskii Institut, Simferopol, Ukrainian SSR) and E. I. KONIAEVA (AN SSSR, Institut Evoliutsionnoi Fiziologii i Biokhimii, Leningrad, USSR) Fiziologicheskii Zhurnal SSSR (ISSN 0015-329X), vol. 75, Nov. 1989, p. 1548-1553. In Russian. refs
Copyright

The effects of antiorthostasis (45-deg) on total cerebral blood flow and on the blood flow and oxygen pressure in the parietal, frontal, occipital, and temporal lobes of the brain cortex were investigated in alert and anesthetized rabbits, using polarography. It was found that 1-hr-long 45-deg antiorthostasis led to substantial changes of local blood flow and oxygen pressure in various cortex regions, as well as in total cerebral blood flow, against the background of a hypertensive reaction and a decrease of heart rate. Differences in the reaction of the brain vessels to antiorthostasis were particularly obvious within the first few minutes. I.S.

A90-24747
CEREBROVASCULAR EFFECTS OF MOTION SICKNESS [TSEREBRO-VASKULIARNYE EFFEKTY UKACHIVANIIA]
IU. E. MOSKALENKO, A. I. BEKETOV, V. F. MAKSIMUK, and N. A. SKOROMNYI (AN SSSR, Institut Evoliutsionnoi Fiziologii i Biokhimii, Leningrad, USSR; Krymskii Meditsinskii Institut, Simferopol, Ukrainian SSR) Fiziologicheskii Zhurnal SSSR (ISSN 0015-329X), vol. 75, Nov. 1989, p. 1560-1567. In Russian. refs
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The cerebrovascular effects of rocking motion leading to motion sickness were investigated in rabbits fitted with implanted electrodes, by measuring cerebral blood flow and the reactivity of cerebral vessels to functional chemical and physical stimuli. It was found that, during motion sickness, the level of cerebral blood flow increased but the ability of the brain circulation system to react to chemical and physical stimuli (such as inhalation of air containing 10 percent CO2 and abdomen compression in the Stookey test, respectively) decreased. This suggests a reduction of the compensatory capacity of the brain circulation system, which can result in a change of the brain tissue water balance leading to an alteration of cerebral outflow sometimes observed in motion sickness. This interpretation was corroborated by the evidence of a change in cerebral tissue impedance observed under the combined effects of motion sickness and antiorthostasis. I.S.

A90-24748
PROTECTIVE EFFECT OF VARIOUS TYPES AND REGIMENS OF ADAPTATION TO HYPOXIA ON THE DEVELOPMENT OF STRESS-INDUCED LESIONS IN KM-LINE RATS [PROTEKTORNOE DEISTVIE RAZNYKH VIDOV I REZHIMOV ADAPTATSII K GIPOKSII NA RAZVITIE STRESSOVYKH POVREZHDENII U KRYS LINII KM]
A. L. KRUSHINSKII, T. V. RIASINA, V. B. KOSHELEV, M. N. SOTSKAIA, E. M. BEBINOV (Moskovskii Gosudarstvennyi Universitet; AMN SSSR, Nauchno-Issledovatel'skii Institut Nevrologii, Moscow, USSR) et al. Fiziologicheskii Zhurnal SSSR (ISSN 0015-329X), vol. 75, Nov. 1989, p. 1576-1584. In Russian. refs
Copyright

The effect of preliminary adaptation to hypoxia on the development of stress-induced lesions was investigated on Krushinskii-Molodkina-line rats, which are genetically predisposed to audiogenic seizures, exposed to acoustic stress. It was found that adaptation to hypoxia (administered in the form of long-term, short-term, continuous, or intermittent regimens) resulted in decreases of the death rate, the severity of motor disorders, and the incidence and degree of intracranial hemorrhages in rats exposed to acoustic stress. A two-hour normobaric hypoxic stimulation prevented an increase in lipid peroxidation products in stress-exposed rats, and contributed to a rise of cyclic nucleotides in the brain hemispheres. I.S.

A90-24749
EFFECT OF UNILATERAL CAROTID-ARTERY OCCLUSION ON THE CEREBRAL BLOOD FLOW IN RATS EXPOSED TO HYPOXIA [VLIIANIE ODNOSTORONNEI OKKLIUZII SONNOI ARTERII NA MOZGOVOI KROVOTOK KRYS V USLOVIIAKH GIPOKSII]
B. B. IRIPKHANOV and SH. A. ALIEV (Chechen-Ingushskii Gosudarstvennyi Universitet, Grozny, USSR) Fiziologicheskii Zhurnal SSSR (ISSN 0015-329X), vol. 75, Nov. 1989, p. 1585-1588. In Russian. refs
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A90-24750
FUNCTIONING OF THE CEREBRAL CIRCULATION SYSTEM IN RABBITS UNDER HYPERTHERMIA [FUNKTSIONIROVANIE SISTEMY MOZGOVOGO KROVOOBRASHCHENIIA KROLIKOV PRI GIPERTERMII]
G. B. VAINSHTEIN, G. B. KARADZHAEVA, and A. I. KRIVCHENKO (AN SSSR, Institut Evoliutsionnoi Fiziologii i Biokhimii, Leningrad, USSR) Fiziologicheskii Zhurnal SSSR (ISSN 0015-329X), vol. 75, Nov. 1989, p. 1608-1615. In Russian. refs
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The effect of hyperthermia (to 41 C rectal temperature) on the cerebral circulation system was investigated by measuring various parameters of cardiovascular and cerebrovascular systems in rabbits maintained in a chamber with 45-47 C air temperature and 27-30 percent relative humidity. It was found that, as a result of hyperthermia, the cortical blood flow decreased by 20-25 percent, due to hypercapnia and the constriction of arterioles, whereas the blood flow in the thalamus and hypothalamus remained unchanged or increased slightly. As the body temperature increased, the reactivity of cerebral vessels to CO2 inhalation and orthostatic load decreased. There was evidence of the hemato-encephalic barrier lesion, and of an increase of the water content by 3-4

percent in the cortex and the white matter. Administration of flunarizine (a calcium-blocking agent) was found to restore the cerebral blood flow level and the reactivity of cerebral vessels. I.S.

A90-25329* California Univ., Berkeley.
BIOPHYSICAL ASPECTS OF HEAVY ION INTERACTIONS IN MATTER
WALTER SCHIMMERLING, MERVYN WONG, BERNHARD LUDEWIGT, MARK PHILLIPS, EDWARD L. ALPEN, PATRICIA POWERS-RISIUS, RANDY J. DEGUZMAN (California, University, Berkeley), LARRY W. TOWNSEND, and JOHN W. WILSON (NASA, Langley Research Center, Hampton, VA) IN: High-energy radiation background in space. New York, American Institute of Physics, 1989, p. 369-380. refs
(Contract NIH-CA-23247; NASA ORDER L-22395-A; DE-AC03-76SF-00098)

The biological effects of high energy, high charge nuclei (HZE particles) occupy a central role in the management of space radiation hazards due to galactic cosmic rays. For the energy range of interest, the mean free path for nuclear interactions of these heavy ions is comparable to the thickness of the material traversed, and a significant fraction of stopping particles will undergo a nuclear reaction with the nuclei of the stopping material. Transport methods for HZE particles are dependent on models of the interaction of man-made systems with the space environment to an even greater extent than methods used for other types of radiation. Hence, there is a major need to validate these transport codes by comparison with experimental data. The basic physical properties of HZE particles will be reviewed and illustrated with the results of nuclear fragmentation experiments performed with 670A MeV neon ions incident on a water absorber and with measurements of multiple Coulomb scattering of uranium beams in copper. Finally, the extent to which physical measurements yield radiobiological predictions is illustrated for the example of neon. Author

A90-25330
DELAYED EFFECTS OF PROTON IRRADIATION IN MACACA MULATTA (22-YEAR SUMMARY)
D. H. WOOD, K. A. HARDY, A. B. COX, Y. L. SALMON, M. G. YOCHMOWITZ (USAF, School of Aerospace Medicine, Brooks AFB, TX) et al. IN: High-energy radiation background in space. New York, American Institute of Physics, 1989, p. 381-392. refs

Lifetime observations on a group of rhesus monkeys indicate that life expectancy loss from exposure to protons in the energy range encountered in the Van Allen belts and solar proton events can be correlated with the dose and energy of radiation. The primary cause of life shortening is nonleukemic cancers. Radiation also increased the risk of endometriosis (an abnormal proliferation of the lining of the uterus in females). Other effects associated with radiation exposures are lowered glucose tolerance and increased incidence of cataracts. Calculatins of the relative risk of fatal cancers in the irradiated subjects reveal that the total body surface dose required to double the risk of death from cancer over a 20-year post exposure period varies with the linear energy transfer (LET) of the radiation. The ability to determine the integrated dose and LET spectrum in space radiation exposures of humans is, therefore, critical to the assessment of lifetime cancer risk. Author

A90-25331
RESPONSE OF CARAUSIUS MOROSUS TO SPACEFLIGHT ENVIRONMENT
G. REITZ, H. BUECKER, R. FACIUS, G. HORNECK (DLR, Institut fuer Flugmedizin, Cologne, Federal Republic of Germany), W. RUETHER (Marburg, Universitaet, Federal Republic of Germany) et al. IN: High-energy radiation background in space. New York, American Institute of Physics, 1989, p. 393-406. refs

The combined effects of cosmic HZE-particle radiation and microgravity on the development of the stick insect Carausius morosus from the egg stage were investigated experimentally in a Biorack experiment on Spacelab mission D-1. The hardware setup and experimental protocol are described, and the results are presented in tables and graphs. It is shown that the number of morphological anomalies induced in the insect larvae by the combination of cosmic radiation and microgravity was significantly larger than that induced by radiation or microgravity alone or than the sum of these two effects. Possible mechanisms for this potentiation phenomenon are considered, and the need for further space experiments is indicated. T.K.

A90-25332
THE PROTONS OF SPACE AND BRAIN TUMORS. I - CLINICAL AND DOSIMETRIC CONSIDERATIONS
G. V. DALRYMPLE, W. A. NAGLE, A. J. MOSS, L. A. CAVIN, J. R. BROADWATER (John L. McClellan Memorial Veterans Hospital; Arkansas, University, Little Rock) et al. IN: High-energy radiation background in space. New York, American Institute of Physics, 1989, p. 407-411. refs

Almost 25 years ago a large group of Rhesus monkeys were irradiated with protons (32-2300 MeV). The initial results showed the relative biological effectiveness to be about 1.0 for acute radiation effects (mortality, hematologic changes, etc.). The colony has been maintained at Brooks AFB since irradiation. The survivors of 55-MeV proton irradiation have developed a very high incidence of glioblastoma multiforme, a highly malignant primary brain tumor. These tumors appeared 1-20 yrs after surface doses of 400-800 rads. Reconstruction of the dosimetry suggests that some areas within the brain may have received doses of 1500-2500 rads. More than 30 radiation-induced glioblastomas have been reported in human patients who received therapeutic head irradiation. The radiation doses required to induce glioblastoma were of the same order of magnitude as required to induce glioblastoma in the Rhesus monkey. Author

A90-25333
THE PROTONS OF SPACE AND BRAIN TUMORS. II - CELLULAR AND MOLECULAR CONSIDERATIONS
W. A. NAGLE, A. J. MOSS, JR., G. V. DALRYMPLE (John L. McClellan Veterans Hospital; Arkansas, University, Little Rock), A. B. COX, J. F. WIGLE (USAF, School of Aerospace Medicine, Brooks AFB, TX) et al. IN: High-energy radiation background in space. New York, American Institute of Physics, 1989, p. 412-431. refs

An increased incidence of highly malignant gliomas, (glioblastoma multiforme) has been observed in Rhesus monkeys irradiated with 55-MeV protons, and in humans treated with therapeutic irradiation to the head. The results suggest a radiation etiology for these tumors. This paper reviews briefly some characteristics of glioma tumors and summarizes the genetic changes associated with malignant gliomas in experimental animals and in humans. The genetic abnoramlities include cytogenetic alterations and changes in the structure and expression of specific oncogenes. Also reviewed are some recent data concerning the molecular nature of radiation-induced somatic-cell mutation and oncogene activation. Finally, some implications of these results are discussed in relation to human radiation exposure in space. Author

A90-25334
PROMOTION OF A NEW RADIOPROTECTIVE ANTIOXIDATIVE AGENT
J. MATSUBARA, A. IKEDA, and T. KINOSHITA (Tokyo, University, Japan) IN: High-energy radiation background in space. New York, American Institute of Physics, 1989, p. 434-441. refs

The mechanisms involved in radioprotective pre- or posttreatments with Zn, Mn, or biological-response modifiers (BRMs) were investigated experimentally in 7-week-old mice exposed to whole-body X-ray irradiation of 6.5 or 7.5 Gy. The focus was on the role of the heavy-metal-binding protein

metallothionein (MT), produced in the liver, in the development of a tolerance to radiation damage. The experimental protocols are described in detail, and the results are presented in tables and graphs. It is shown that administration of Mn, Zn, or BRMs (and especially a combination of metallic salt and BRM) prior to or even after irradiation significantly increased MT production and also protected the mice against lethal damage. The potential benefits of this type of therapy for space crews are briefly considered. T.K.

A90-26010* California Univ., Los Angeles.
INFLUENCE OF 7 DAYS OF HINDLIMB SUSPENSION AND INTERMITTENT WEIGHT SUPPORT ON RAT MUSCLE MECHANICAL PROPERTIES
DAVID J. PIEROTTI, ROLAND R. ROY, VINICIO FLORES, and REGGIE EDGERTON (California, University, Los Angeles) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 61, March 1990, p. 205-210. refs
(Contract NIH-NS-16333; NCA2-IR-390-502)
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The effect of intermittent periods of weight support on a decrease in mass of the soleus (Sol) and medial gastrocnemius (MG) muscles atrophied by hindlimb suspension (HS) was investigated in rats subjected to continuous HS for seven days or an HS plus intermittent (10 min every 6 hrs of slow walking on a treadmill) weight support (HS-WS). After 7 d HS, the Sol weight relative to body weight was 21 and 9 percent lower in Hs and HS-WS, respectively, than in control rats. Maximum tetanic tension/muscle mass ratio was significantly lower in HS than in controls; the HS-WS rats had values similar to controls, whereas the maximum tetanic tension/muscle weight was significantly elevated in HS-WS compared to controls. Contraction times were 25 percent faster in the Sol and unchanged in the MG of HS rats, indicating that a low-force short-duration exercise regime results in a significant functional recovery in the 'slow' Sol, whereas the 'fast' MG is less affected. I.S.

A90-26319* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
EFFECT OF BODY WEIGHT GAIN ON INSULIN SENSITIVITY AFTER RETIREMENT FROM EXERCISE TRAINING
CONSTANTINE B. DOLKAS (NASA, Ames Research Center, Moffett Field, CA), KENNETH J. RODNICK (Stanford University, CA), and CARL E. MONDON (USVA, Geriatric Research, Education, and Clinical Center, Palo Alto, CA) Journal of Applied Physiology (ISSN 0161-7567), vol. 68, Feb. 1990, p. 520-526. refs
Copyright

The effect of the body-weight gain after retirement from an exercise-training program on the retained increase in insulin sensitivity elicited by the training was investigated in exercise-trained (ET) rats. Insulin sensitivity was assessed by oral glucose tolerance and insulin suppression tests immediately after training and during retirement. Results show that, compared with sedentary controls, exercise training enhanced insulin-induced glucose uptake, but the enhanced sensitivity was gradually lost with the end of running activity until after seven days of retirement, when it became equal to that of controls. This loss of enhanced sensitivity to insulin was associated with an accelerated gain in body weight beginning one day after the start of retirement. However, those animals that gained weight only at rates similar to those of control rats, retained their enhanced sensitivity to insulin. I.S.

A90-26321* Arizona Univ., Tucson.
INFLUENCE OF SINGLE HINDLIMB SUPPORT DURING SIMULATED WEIGHTLESSNESS IN THE RAT
CRAIG S. STUMP, J. MICHAEL OVERTON, and CHARLES M. TIPTON (Arizona, University, Tucson) Journal of Applied Physiology (ISSN 0161-7567), vol. 68, Feb. 1990, p. 627-634. refs
(Contract NAG2-392)
Copyright

A study was carried out to develop and evaluate a hindlimb suspension model, making it possible to differentiate the effects of non-weight bearing by hindlimbs per se from the systemic influence of simulated weightlessness. A support platform was designed which allowed the animal to maintain one hindlimb in a posture similar to the hindlimbs of the control animals at rest and to maintain one hindlimb in a posture similar to the hindlimbs of the control animals, providing a support for the animal to contract or stretch hindlimb muscles against at any time during suspension. The results of this study indicated that hindlimb support during head-down suspension will maintain muscle-mass/body-mass ratios, glycogen concentration, and blood flow. However, it will not prevent the loss in citrate synthase activity associated with conditions of simulated weightlessness. I.S.

A90-26378
NEUROPHYSIOLOGICAL MECHANISMS OF OCULOMOTOR BEHAVIOR IN MAMMALS [NEIROFIZIOLOGICHESKIE MEKHANIZMY GLAZODVIGATEL'NOGO POVEDENIIA MLEKOPITAIUSHCHIKH]
V. V. SHUL'GOVSKII, B. M. SHELIGA, and S. K. PROKOF'EV (Moskovskii Gosudarstvennyi Universitet, Moscow, USSR) Uspekhi Fiziologicheskikh Nauk (ISSN 0301-1798), vol. 21, Jan.-Mar. 1990, p. 62-77. In Russian. refs
Copyright

Mechanisms responsible for the coordinated head and eye movements in the course of a saccade are discussed on the basis of a review of published results. Attention is given to works concerned with saccadic eye movement characterization, the coordinated head-eye movements during the change of the point of fixation, the neurophysiological mechanisms responsible for the shift of the eye focus, the phenomenology of tracking moving visual targets, and the neurophysiological mechanisms of the head-eye movements involved in tracking a moving target. I.S.

A90-26379
EMOTIONAL STRESS, POSTURAL REGULATION OF BLOOD CIRCULATION, AND SOME DISCREPANCIES IN THE CONCEPTS OF ARTERIAL HYPERTROPHY PATHOGENESIS [EMOTSIONAL'NOE NAPRIAZHENIE, POSTURAL'NAIA REGULIATSIIA KROVOOBRASHCHENIIA I NEKOTORYE PROTIVORECHIIA V PREDSTAVLENIIAKH O PATOGENEZE ARTERIAL'NOI GIPERTONII]
G. S. BELKANIIA, V. A. DARTSMELIIA, A. N. DEMIN, M. V. GALUSTIAN, I. P. SHEREMET (AMN SSSR, Institut Eksperimental'noi Patologii i Terapii, Sukhumi, Georgian SSR) et al. Uspekhi Fiziologicheskikh Nauk (ISSN 0301-1798), vol. 21, Jan.-Mar. 1990, p. 78-96. In Russian. refs
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A90-26566
EARLY CARBONIFEROUS LOW-TEMPERATURE HYDROTHERMAL VENT COMMUNITIES FROM NEWFOUNDLAND
PETER H. VON BITTER (Royal Ontario Museum; Toronto, University, Canada), STEVEN D. SCOTT (Toronto, University, Canada), and PAUL E. SCHENK (Dalhousie University, Halifax, Canada) Nature (ISSN 0028-0836), vol. 344, March 8, 1990, p. 145-148. refs
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Fossil tubes, an abundant low-diversity fauna, and sulfide mineralization in 340-Myr-old Carboniferous carbonate mounds in Newfoundland are described. These features, together with evidence for microbial activity, point to the existence of a seventh chemosynthetic community, clustered around low-temperature hydrothermal vents. The remarkable preservation of this community permits a direct comparison to be made with the composition and structure of modern vent communities. C.D.

A90-27442
EVOLUTION OF SPACE STATION - LIFE SCIENCES PROGRAM AND FACILITIES
SJOERD L. BONTING (SETI Institute, Moffett Field, CA) SAE,

Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 13 p. refs
(SAE PAPER 891474) Copyright

The needs for life sciences research and facilities on Space Station in Phase 2, based on future space exploration and utilization plans, are discussed. The assumed scenario involves a Lunar Base, manned missions to Mars, and an orbiting Space Colony for the production of Solar Power Satellites permitting replacement of fossil fuels by the middle of the next century. From this scenario, the contours of a life sciences program for the period after 1998 are derived. Based on the main elements of such a program, the major new life sciences facilities needed in Phase 2 are identified. It is concluded that a full-length dedicated life sciences module and an attached short module with large centrifuge and animal research facilities, as well as a man-rated variable research facility and other attached facilities are needed. A proposed deployment schedule for these facilities is presented. Should replacement of fossil fuels by space-derived solar power not be necessary, then the same elements and facilities will be needed, but the schedule can be relaxed. Author

A90-27455* Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THE NEMATODE C. ELEGANS - A MODEL ANIMAL SYSTEM FOR THE DETECTION OF GENETIC AND DEVELOPMENTAL LESIONS
GREGORY A. NELSON, TAMARA M. MARSHALL, and WAYNE W. SCHUBERT (JPL, Pasadena, CA) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 5 p. refs
(Contract NAS7-918)
(SAE PAPER 891488) Copyright

The effects of ionizing and nonionizing radiation effects on cell reproduction, differentiation, and mutation in vivo are studied using the nematode C. elegans. The relationships between fluence/dose and response and quality factor and linear energy transfer are analyzed. The data reveal that there is a complex repair pathway in the nematode and that mutants can be used to direct the sensitivity of the system to specific mutagens/radiation types. I.F.

A90-27456
MOUSE TAIL-SUSPENSION AS A MODEL OF MICROGRAVITY - EFFECTS ON SKELETAL, NEURAL AND MUSCULAR SYSTEMS
S. SIMSKE, C. SOMPS, E. GAYLES, L. S. STODIECK, H. WACHTEL (Colorado, University, Boulder) et al. SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 12 p. refs
(SAE PAPER 891489) Copyright

Tail-suspension of rats has been shown to cause loss of bone mass similar to that experienced by humans in microgravity. Tail-suspension is presently applied to mice to characterize bone, nervous system and muscle changes that occur, and evaluate the use of magnetic fields to obviate these changes. Results have shown that femurs and tibiae of tail-suspended mice undergo significant decreases in dry weight, stiffness and strength. Immersion of mice in specific oscillating magnetic fields can reduce or eliminate these degenerative changes. Results have also shown that tail-suspended animals undergo changes in spinal cord function similar to changes previously observed in animals with damaged sciatic nerves. Author

A90-27458* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
ECOLOGY OF MICRO-ORGANISMS IN A SMALL CLOSED SYSTEM - POTENTIAL BENEFITS AND PROBLEMS FOR SPACE STATION
E. B. RODGERS (NASA, Marshall Space Flight Center, Huntsville, AL), D. B. SEALE, M. E. BORAAS, and C. V. SOMMER (Wisconsin, University, Milwaukee) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 10 p. refs
(SAE PAPER 891491) Copyright

The probable sources and implications of microbial contamination on the proposed Space Station are discussed. Because of the limited availability of material, facilities and time on the Space Station, we are exploring the feasibility of replacing traditional incubation methods for assessing microbial contamination with rapid, automated methods. Some possibilities include: ATP measurement, microscopy and telecommunications, and molecular techniques such as DNA probes or monoclonal antibodies. Some of the important ecological factors that could alter microbes in space include microgravity, exposure to radiation, and antibiotic resistance. Author

A90-27459* Wisconsin Univ., Milwaukee.
THE USE OF MODELS TO PREDICT POTENTIAL CONTAMINATION ABOARD ORBITAL VEHICLES
MARTIN E. BORAAS and DIANNE B. SEALE (Wisconsin, University, Milwaukee) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 8 p. refs
(Contract NAS8-37914)
(SAE PAPER 891492) Copyright

A model of fungal growth on air-exposed, nonnutritive solid surfaces, developed for utilization aboard orbital vehicles is presented. A unique feature of this testable model is that the development of a fungal mycelium can facilitate its own growth by condensation of water vapor from its environment directly onto fungal hyphae. The fungal growth rate is limited by the rate of supply of volatile nutrients and fungal biomass is limited by either the supply of nonvolatile nutrients or by metabolic loss processes. The model discussed is structurally simple, but its dynamics can be quite complex. Biofilm accumulation can vary from a simple linear increase to sustained exponential growth, depending on the values of the environmental variable and model parameters. The results of the model are consistent with data from aquatic biofilm studies, insofar as the two types of systems are comparable. It is shown that the model presented is experimentally testable and provides a platform for the interpretation of observational data that may be directly relevant to the question of growth of organisms aboard the proposed Space Station. R.E.P.

A90-27478
THE CHALLENGE OF INTERNAL CONTAMINATION IN SPACECRAFT, STATIONS, AND PLANETARY BASES
JON R. SCHULZ (Martin Marietta Corp., Astronautics Group, Denver, CO) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 8 p. refs
(SAE PAPER 891512) Copyright

The problem of internal contamination is examined with emphasis on a contamination assessment and management program based on a graphic model of potential contaminant sources, flow paths, and sensitive receptors. The model provides a basis for systematically identifying issues, assessing risk, identifying where the knowledge base must evolve, and mitigating significant effects. Potential solutions to internal contamination problems are discussed. V.L.

A90-27482* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
THE RODENT RESEARCH ANIMAL HOLDING FACILITY AS A BARRIER TO ENVIRONMENTAL CONTAMINATION
P. D. SAVAGE, JR., G. C. JAHNS, B. P. DALTON, R. P. HOGAN (NASA, Ames Research Center, Moffett Field, CA), and A. E. WRAY (GE Government Services Co., Moffett Field, CA) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 10 p. Previously announced in STAR as N90-12151.
(SAE PAPER 891517) Copyright

The rodent Research Animal Holding Facility (RAHF), developed by NASA Ames Research Center (ARC) to separately house rodents in a Spacelab, was verified as a barrier to environmental contaminants during a 12-day biocompatibility test. Environmental contaminants considered were solid particulates,

microorganisms, ammonia, and typical animal odors. The 12-day test conducted in August 1988 was designed to verify that the rodent RAHF system would adequately support and maintain animal specimens during normal system operations. Additional objectives of this test were to demonstrate that: (1) the system would capture positive Instrument-Expressive profile (high achievement mo- organisms would be contained; and (3) the passage of animal odors was adequately controlled. In addition, the amount of carbon dioxide exhausted by the RAHF system was to be quantified. Of primary importance during the test was the demonstration that the RAHF would contain particles greater than 150 micrometers. This was verified after analyzing collection plates placed under exhaust air ducts and and rodent cages during cage maintenance operations, e.g., waste tray and feeder changeouts. Microbiological testing identified no additional organisms in the test environment that could be traced to the RAHF. Odor containment was demonstrated to be less than barely detectable. Ammonia could not be detected in the exhaust air from the RAHF system. Carbon dioxide levels were verified to be less than 0.35 percent. Author

A90-27532* Tuskegee Inst., AL.
SWEET POTATO GROWTH PARAMETERS, YIELD COMPONENTS AND NUTRITIVE VALUE FOR CELSS APPLICATIONS
P. A. LORETAN, C. K. BONSI, W. A. HILL, C. R. OGBUEHI, D. G. MORTLEY (Tuskegee University, AL) et al. SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 7 p. Research supported by USDA. refs
(Contract NAG10-0024)
(SAE PAPER 891571) Copyright

Sweet potatoes have been grown hydroponically using the nutrient film technique (NFT) to provide a potential food source for long-term manned space missions. Experiments in both sand and NFT cultivars have produced up to 1790 g/plant of fresh storage root with an edible biomass index ranging from 60-89 percent and edible biomass linear growth rates of 39-66 g/sq m day in 105 to 130 days. Experiments with different cultivars, nutrient solution compositions, application rates, air and root temperatures, photoperiods, and light intensities indicate good potential for sweet potatoes in CELSS. Author

A90-27533* Utah State Univ., Logan.
CARBON USE EFFICIENCY IN OPTIMAL ENVIRONMENTS
BRUCE BUGBEE (Utah State University, Logan) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 8 p. Research supported by NASA. refs
(SAE PAPER 891572) Copyright

The short- and long-term effects of environmental changes on plant productivity are studied using a model in which yield is determined by four factors: absorption of photosynthetic photon flux, photosynthetic efficiency, respiratory carbon use efficiency, and harvest index. The characteristics of the model are reviewed. Emphasis is given to the relationship between carbon use efficiency and yield. The biochemical pathways resulting in CO2 efflux are examined, including photorespiration, cyanide-resistant respiration, and dark respiration. The possibility of measuring photosynthesis and respiration in a CELSS is discussed. R.B.

A90-27611* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
3-D COMPONENTS OF A BIOLOGICAL NEURAL NETWORK VISUALIZED IN COMPUTER GENERATED IMAGERY. I - MACULAR RECEPTIVE FIELD ORGANIZATION
MURIEL D. ROSS (NASA, Ames Research Center, Moffett Field, CA), LYNN CUTLER, GLENN MEYER, TONY LAM, and PARSHAW VAZIRI (Sterling Software, Palo Alto, CA) Acta Oto-Laryngologica (ISSN 0001-6489), vol. 109, 1990, p. 83-92. refs
Copyright

Computer-assisted, 3-dimensional reconstructions of macular receptive fields and of their linkages into a neural network have revealed new information about macular functional organization. Both type I and type II hair cells are included in the receptive fields. The fields are rounded, oblong, or elongated, but gradations between categories are common. Cell polarizations are divergent. Morphologically, each calyx of oblong and elongated fields appears to be an information processing site. Intrinsic modulation of information processing is extensive and varies with the kind of field. Each reconstructed field differs in detail from every other, suggesting that an element of randomness is introduced developmentally and contributes to endorgan adaptability. Author

A90-27622* San Francisco Univ., CA.
DESCENDING PATHWAYS TO THE CUTANEUS TRUNCI MUSCLE MOTONEURONAL CELL GROUP IN THE CAT
GERT HOLSTEGE (California, University, San Francisco) and BERTIL F. BLOK (Rotterdam, Universiteit, Netherlands) Journal of Neurophysiology (ISSN 0022-3077), vol. 62, Dec. 1989, p. 1260-1269. Research supported by the R. A. Laan Fonds, A. A. van Beek Fonds, Fundatie van Vrijvrouwe van Renswoude, Bekker-La Bastide Fonds, and Universiteit Rotterdam. refs
(Contract NCC2-491)
Copyright

The descending pathways to the motoneuronal cell group of the cutaneous trunci muscle (CTM) of the cat were investigated by injecting H-3-labeled lucine into the brain stem, the diencephalon, or the C1, C2, C6, and C8 segments of the spinal cord, and examining fixed autoradiographic sections of the spinal cord and brain regions. Results demonstrate presence of specific supraspinal projectons to the CTM motor nucleus originating in the contralateral nucleus retroambiguous and the ipsilateral dorsolateral pontine tegmentum. Results also suggest that propriospinal pathways to the CTM motor nucleus originating in the cervical cord do not exist, although these propriospinal projections to all other motoneuronal cell groups surrounding the CTM nucleus are very strong. I.S.

A90-27626* California Univ., San Francisco.
LACK OF EFFECT OF VASOPRESSIN REPLACEMENT ON RENIN HYPERSECRETION IN BRATTLEBORO RATS
RAFFAELLO M. A. GOLIN, EIJI GOTOH, LANNY C. KEIL, ROY L. SHACKELFORD, and WILLIAM F. GANONG (California, University, San Francisco; NASA, Ames Research Center, Moffett Field, CA) American Journal of Physiology: Regulatory, Integrative and Comparative Physiology (ISSN 0363-6119), vol. 26, 1989, p. R1117-R1122. Research supported by the Smokeless Tobacco Research Council. refs
(Contract NIH-HL-29714; NAG2-434)
Copyright

The congenital vasopressin deficiency in homozygous Brattleboro rats with diabetes insipidus is associated with elevated plasma renin activity at rest and supernormal responses to stimuli that increase renin secretion. The mechanism underlying this phenomenon was investigated by infusing homozygous and heterozygous Brattleboro rats with a dose of arginine vasopressin that restored plasma vasopressin to normal in the homozygous animals. The resulting data indicate that increased renin secretion in homozygous rats results from increased sympathetic activity. Because circulating vasopressin does not cross the blood-brain barrier, it seems likely that the increased sympathetic activity is central in origin. C.D.

A90-27627* California Univ., San Francisco.
EFFECTS OF SIMULATED WEIGHTLESSNESS ON RAT OSTEOCALCIN AND BONE CALCIUM
PATRICIA PATTERSON-BUCKENDHAL, RUTH K. GLOBUS, DANIEL D. BIKLE, CHRISTOPHER E. CANN, and EMILY MOREY-HOLTON (California, University; U.S. Veterans Administration Medical Center, San Francisco; NASA, Ames Research Center, Moffett Field, CA) American Journal of Physiology: Regulatory, Integrative and Comparative Physiology (ISSN 0363-6119), vol. 26, 1989, p. R1103-R1109. refs
(Contract NCA2-OR-665-202)
Copyright

The effect of weightlessness on the serum content of the mineral-binding protein osteocalcin (OC), bone OC, and bone Ca

were investigated in rats subjected for periods from 2 to 28 days to a hindlimb unweighting procedure simulating weightlessness. It was found that serum OC decreased by 25 percent (consistent with a decreased rate of bone growth), during the first week of hindlimb suspension, but returned to normal levels after 15 days. The third lumbar vertebra (L3) and femur (analyzed in this study) lost 20 percent of weight after 10-28 days of suspension. Analysis of OC and Ca concentrations and content in L3 and femur suggest a temporal divergence of the metabolism of these two bone components. The OC and Ca concentrations were found to vary not only with respect to the duration of unweighting but also to differ from each other in the magnitude of their response. The data showed that unweighting affects the formation and deposition of OC and Ca differently, depending on the bone location and the duration of unweighting. I.S.

A90-27628* Texas Univ., Houston.
EFFECT OF LYSOPHOSPHATIDYLCHOLINE ON THE FILTRATION COEFFICIENT IN INTACT DOG LUNGS
B. D. BUTLER, I. DAVIES, and R. E. DRAKE (Texas, University, Houston) American Journal of Physiology: Heart and Circulatory Physiology (ISSN 0363-6135), vol. 26, 1989, p. H1466-H1470. refs
(Contract NIH-HL-36635; NIH-HL-27367; NAG9-215)
Copyright

Lysophosphatidylcholine (lyso-Pc) is a lysophospholipid normally found in low concentrations in the lung. At high concentrations lyso-Pc, instilled into the airways, causes pulmonary edema. The hypothesis was tested that the edema caused by lyso-Pc was due to an increase in pulmonary microvascular membrane permeability. In 11 anesthetized dogs, the left lower lobes (LLL) were continuously weighed while lyso-Pc (20 mM) was instilled into the LLL airways. After 30 min, the microvascular membrane fluid filtration coefficient (Kf) was determined from the relationship between the rate of LLL weight gain and the pulmonary microvascular pressure. Kf was not significantly different between the lyso-Pc-treated lobes vs control lobes. The data do not support the hypothesis that lyso-Pc, instilled into the airways, causes an increase in pulmonary microvascular permeability. Author

N90-17251*# National Aeronautics and Space Administration, Washington, DC.
THE 1988-1989 NASA SPACE/GRAVITATIONAL BIOLOGY ACCOMPLISHMENTS
THORA W. HALSTEAD, ed. Jan. 1990 225 p Prepared in cooperation with George Washington Univ., Washington, DC
(Contract NASW-4324)
(NASA-TM-4160; NAS 1.15:4160) Avail: NTIS HC A10/MF A02
CSCL 06C

This report consists of individual technical summaries of research projects of NASA's space/gravitational biology program, for research conducted during the period May 1988 to April 1989. This program is concerned with using the unique characteristics of the space environment, particularly microgravity, as a tool to advance knowledge in the biological sciences; understanding how gravity has shaped and affected life on Earth; and understanding how the space environment affects both plant and animal species. The summaries for each project include a description of the research, a list of the accomplishments, an explanation of the significance of the accomplishments, and a list of publications. Author

N90-17252* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
BIO-REACTOR CHAMBER Patent
JOSEPH A. CHANDLER, inventor (to NASA) 13 Jun. 1989 9 p
(NASA-CASE-MSC-20929-1; US-PATENT-4,839,046;
US-PATENT-APPL-SN-087358; US-PATENT-CLASS-210-355;
US-PATENT-CLASS-210-414; US-PATENT-CLASS-435-311;
US-PATENT-CLASS-435-316) Avail: U.S. Patent and Trademark
CSCL 06C

A bioreactor for cell culture is disclosed which provides for the introduction of fresh medium without excessive turbulent action. The fresh medium enters the bioreactor through a filter with a backwash action which prevents the cells from settling on the filter. The bioreactor is sealed and depleted medium is forced out of the container as fresh medium is added.
Official Gazette of the U.S. Patent and Trademark Office

N90-18133# Central Research Inst. of Electric Power Industry, Chiba (Japan).
BREEDING OF HYDROGEN PRODUCING ANAEROBIC BACTERIA. CELLULASE SECRETION FROM TRANSFORMED ESCHERICHIA COLI JM109
SEIGO SHIMA Jan. 1989 16 p In JAPANESE; ENGLISH summary
(DE90-710739; CRIE-U-88055) Avail: NTIS (US Sales Only) HC A03/MF A01

One of the applications of biotechnology to the electric power industry is production of hydrogen for fuel cells by microorganisms. This study is to conduct breeding of the microorganism which decomposes cellulose, the main component of plant, and produces hydrogen efficiently by using the gene manipulation methods. When cellulose decomposing enzyme genes were introduced into Escherichia coli JM109 whose cell membrane structure varied partially and the places where the cellulose decomposing enzyme existed inside as well as outside its body were checked, it was found that the majority of the cellulose decomposing enzymes were discharged towards the outside of the body beyond the surface space of the cell. This phenomenon is the academically important information, but from the practical standpoint, the ability of discharging into the cell surface space using such Escherichia coli without variations as Escherichia coli HB101 is required, hence it is desired to obtain the gene which has the discharging ability as stated above and produces cellulose decomposing enzymes with strong decomposing power. DOE

N90-18134# Naval Medical Research Inst., Bethesda, MD.
ARGININE VASOPRESSIN LOWERS PULMONARY ARTERY PRESSURE IN HYPOXIC RATS BY RELEASING ARTRIAL NATRIURETIC PEPTIDE
HONGKUI JIN, YIU-FAI CHEN, REN-HUI YANG, THOMAS M. MCKENNA, ROBERT M. JACKSON, and SUZANNE OPARI 6 Dec. 1988 42 p Sponsored by Department of the Navy, Washington, DC; National Dairy Board; and National Dairy Council
(Contract HL-35051; HL-22544)
(AD-A215986; NMRI-88-94) Avail: NTIS HC A03/MF A01
CSCL 06/15

We previously demonstrated that arginine vasopressin (AVP) lowers pulmonary artery pressure in rats with hypoxic pulmonary hypertension by activation of the V1 receptor. The pulmonary depressor effect of AVP in hypoxia adapted rats is not due to its effect on cardiac output. The current study tested two alternative hypotheses: that AVP lowers pulmonary artery pressure in the hypoxia adapted lung by: (1) dilating pulmonary vasculature directly, or (2) releasing atrial natriuretic peptide (ANP) from the heart. The first hypothesis was tested by injecting AVP into the pulmonary arteries of isolated, buffer perfused lungs and monitoring pulmonary artery pressure, and by exposing preconstricted pulmonary artery rings to graded doses of AVP and monitoring the tension generated. AVP caused minimal vasodilation in prefused lungs and only a small vasodilator effect in pulmonary artery rings. The second hypothesis was tested by injecting AVP (160 ng/kg) or vehicle intravenously in conscious hypoxia adapted (4 weeks) or air control rats and measuring ANP in arterial blood and atria, and by testing pretreatment with the V1 receptor antagonist d(CH2)5 Tyr (Me) AVP (130 micrograms/kg) on the AVP-induced increase in plasma ANP. AVP produced a 7-fold increase in plasma ANP in hypoxia adapted rats and a 5-fold increase in ANP in air controls. ANP release was abolished by pretreatment of both groups with d(CH2)5 Tyr(Me)AVP. GRA

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AEROSPACE MEDICINE

Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

A90-24426
CEREBRAL TISSUE OXYGEN STATUS AND PSYCHOMOTOR PERFORMANCE DURING LOWER BODY NEGATIVE PRESSURE (LBNP)
DAVID H. GLAISTER (USAF, School of Aerospace Medicine, Brooks AFB, TX) and NITA L. MILLER (Rother Development, Inc.; OAO Corp., San Antonio, TX) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 61, Feb. 1990, p. 99-105. refs
Copyright

Cerebral oxygen sufficiency was studied noninvasively, using multiwavelength near-infrared spectrophotometry, in eight subjects exposed to lower body negative pressure (LBNP) of up to -90 mm Hg to induce presyncopal symptoms and signs. LBNP caused only small changes in the foregrain measures until the last 60 s of the exposures, whereupon oxyhemoglobin (HbO2) and oxidized cytochrome c oxidaze fell, reduced hemoglobin (Hb) rose slightly, and the tissue blood volume (HbO2 + Hb) fell. In subjects showing presyncope, these changes anticipated the onset of a terminal bradycardia by some 20 s and may provide the trigger for cardiovascular decompensation, while the cessation of LBNP led to an overshoot in cerebral blood volume suggestive of a reactive hyperemia. Psychomotor testing showed a significant slowing of reaction time with LBNP, but only for the easiest component of a complex task, while saccadic latencies were found to be shortened following LBNP exposure. Author

A90-24427
PHYSIOLOGIC CORRELATES OF PROTECTION AFFORDED BY ANTI-G SUITS
ROBERT W. KRUTZ, JR., ESTRELLA M. FORSTER (Krug International, San Antonio, TX), and RUSSELL R. BURTON (USAF, School of Aerospace Medicine, Brooks AFB, TX) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 61, Feb. 1990, p. 106-111. refs
(Contract F33615-85-C-4503)
Copyright

A new uniform-pressure pneumatic anti-G suit (UPS) was compared with the standard CSU-13B/P anti-G suit, using measurements of blood lactate, heart rate changes, and segmented lower-body blood pooling (by impedance plethysmography). Subjects were exposed to a series of gradual-onset-rate runs (0.1 G/s), rapid-onset-rate runs (6 G/s), and simulated aerial combat maneuvers (SACM) on the USAF School of Aerospace Medicine human-use centrifuge. All measured parameters and subjective reports indicated that increased protection was afforded by the UPS. The impedance plethysmography measurements indicated that prevention of blood pooling in all lower-body segments is the predominant mechanism whereby uniform pressure permits significantly longer times-to-fatigue during SACMs. Author

A90-24428
VASCULAR RESPONSE OF RETINAL ARTERIES AND VEINS TO ACUTE HYPOXIA OF 8000, 10,000, 12,500, AND 15,000 FEET OF SIMULATED ALTITUDE
OLAF BRINCHMANN-HANSEN (Ulleval University Hospital, Oslo, Norway) and KJELL MYHRE (Royal Norwegian Air Force, Institute of Aviation Medicine, Oslo, Norway) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 61, Feb. 1990, p. 112-116. refs
Copyright

The effect of acute hypoxia on the diameters of retinal arteries and veins was investigated in men exposed to four different altitudes (8000, 10,000, 12,500, and 15,000 ft) simulated in a low-pressure chamber. It was found that, already at 8000 ft, the caliber of small arteries increased by 4 percent and that of large (not less than 75 microns diam) arteries by 7 percent after 15 min of exposure. The caliber of large veins, on the other hand, did not change until 15,000 ft, when a 6 percent increase was observed. Large arteries increased in diameter at 10,000 and 15,000 ft by 7 and 8 percent, respectively, and small veins by 9 and 12 percent at the same altitudes. I.S.

A90-24429
THE ROLE OF SMOOTH PURSUIT IN SUPPRESSION OF POST-ROTATIONAL NYSTAGMUS
G. MAGENES, R. SCHMID (Pavia, Universita, Italy), and J. VENTRE (Institut National de la Sante et de la Recherche Medicale, Bron, France) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 61, Feb. 1990, p. 117-124. refs
Copyright

Some authors have suggested that the smooth pursuit system (SPS) may be responsible for nystagmus suppression when a small visual target - stationary with respect to a subject receiving vestibular stimulation in the dark - is presented. Under five experimental conditions, post-rotational vestibular stimulations were combined in different ways with the presentation of a small visual target. The oculomotor responses of 15 normal subjects were recorded and analyzed. The characteristics of nystagmus suppression (latency, dynamics, and nonlinear behavior) seem to be consistent with the hypothesis of SPS participation. A nonlinear mathematical model of the interaction between vestibulo-ocular reflex and SPS is presented. Computer simulation of tne experimental conditions considered in this study provides theoretical results which closely approximate the actual experimental data. Author

A90-24430
EFFECT OF SPECTRAL FLASH ON READAPTATION TIME
LING WANG, PETER GOLDMANN, and BJORN TENGROTH (Karolinska Institutet, Stockholm, Sweden) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 61, Feb. 1990, p. 125-131. Research supported by the Forsvarets Forskningsanstalt. refs
Copyright

The effects of an adapting flash of different colors on human vision were investigated with various flashes and target luminances. The readaptation time (RAT) was measured using optokinetic nystagmus elicited by a projected moving striped pattern in a hemisphere. The RATs were recorded from 26 subjects with a multichannel pen recorder. Two target luminances (0.000011 cd/sq m and 0.000026 cd/sq m and 12 flash wavelengths (449 nm, 456 nm, 468 nm, 477 nm, 498 nm, 502 nm, 520 nm, 565 nm, 580 nm, 591 nm, 622 nm, and 703 nm) were used. A spectral RAT curve was obtained, which showed that the chromatic response of RAT follows this order: green, blue, yellow, red in order of decreasing response. A larger influence of the variation of the target luminance on the RAT was demonstrated at shorter wavelengths. The results also showed that the energy density of the flash has a larger variation with the RAT in blue and green than in red. Author

A90-24432
MODERATE EXERCISE AND HEMODILUTION DURING SLEEP DEPRIVATION
JACK M. GOODMAN (Toronto, University, Canada), MICHAEL J. PLYLEY, LUCY E. M. HART, MANNY RADOMSKI, and ROY J. SHEPHARD (Toronto, University; Defence and Civil Institute of Environmental Medicine, Downsview, Canada) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 61, Feb. 1990, p. 139-144. Research supported by the Defence and Civil Institute of Environmental Medicine. refs
Copyright

The effect of sleep deprivation, with or without physical exercise, on the blood constituents of humans was investigated in 12 young women who were isolated individually for 52 h without time cues and asked to perform a sequence of cognitive tasks. In the first experiment, without the exercise, there were significant decreases

in hematocrit and red cell count over the first 24 hours, reaching a subsequent plateau or partial recovery. The plasma volume increased by 10.7 percent at 52 hr. The plasma pH showed a progressive fall from a baseline value of 7.381 to 7.332 at 52 h, while plasma bicarbonate decreased from a baseline value of 31.2 mM/L to the value of 26-27 mM/L. After eight weeks, all subjects repeated the experiment, but with the introduction of 30 min of exercise in the 40th hour of wakefulness. Following the exercise bout, the hematocrit and plasma volume increased, rather than reaching a plateau, as in the first experiment. Plasma pH increased with exercise, but returned to the previous low level at 52 hr.

I.S.

A90-24433
FUNCTIONAL ENDOSCOPIC SINUS SURGERY IN AVIATORS WITH RECURRENT SINUS BAROTRAUMA

WILLIAM E. BOLGER, DAVID S. PARSONS (USAF, Medical Center, Lackland AFB, TX), and RAYMOND E. MATSON (USAF, School of Aerospace Medicine, Brooks AFB, TX) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 61, Feb. 1990, p. 148-156. refs

Recurrent sinus barotrauma in an aviator is difficult to treat successfully. Exacerbations frequently result in marked aviator discomfort, cycles of temporary restriction from aviation duties, or even permanent disqualification for flying duties. Medical management and standard sinus operations are often ineffective, seldom curative, and have a disappointing record in returning the aviator to flying duties. Detailed computerized tomographic scanning of the paranasal sinuses coupled with the functional endoscopic sinus surgery approach directs treatment at the causative pathology. Sinus ventilation is improved while making possible a return to active flight status without recurrence of sinus barotrauma. Initial experience with the functional endoscopic sinus surgery technique in such a patient population is reported. A discussion of recurrent sinus barotrauma, paranasal sinus anatomy, and the theory of endoscopic surgical management for sinus disease is included. Author

A90-24434* Louisiana State Univ., Shreveport.
THERAPEUTIC EFFECTS OF ANTIMOTION SICKNESS MEDICATIONS ON THE SECONDARY SYMPTOMS OF MOTION SICKNESS

C. D. WOOD, J. J. STEWART, M. J. WOOD, J. E. MANNO, B. R. MANNO (Louisiana State University, Medical Center, Shreveport) et al. Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 61, Feb. 1990, p. 157-161. refs

(Contract NAG9-167)

In addition to nausea and vomiting, motion sickness involves slowing of brain waves, loss of performance, inhibition of gastric motility and the Sopite Syndrome. The therapeutic effects of antimotion sickness drugs on these reactions were evaluated. The subjects were rotated to the M-III end-point of motion sickness. Intramuscular (IM) medications were then administered. Side effects before and after rotation were reported on the Cornell Medical Index. Brain waves were recorded on a Grass Model 6 Electroencephalograph (EEG), and gastric emptying was studied after an oral dose of 1 mCi Technetium 99m DTPA in 10 oz. isotonic saline. An increase in dizziness and drowsiness was reported with placebo after rotation. This was not prevented by IM scopolamine 0.1 mg or ephedrine 25 mg. EEG recordings indicated a slowing of alpha waves with some thea and delta waves from the frontal areas after rotation. IM ephedine and dimenhydrinate counteracted the slowing while 0.3 mg scopolamine had an additive effect. Alterations of performance on the pursuit meter correlated with the brain wave changes. Gastric emptying was restored by IM metoclopramide. Ephedrine IM but not scopolamine is effective for some of the secondary effects of motion sickness after it is established. Author

A90-24435
NEW PERSPECTIVES IN THE TREATMENT OF HYPOXIC AND ISCHEMIC BRAIN DAMAGE - EFFECT OF GANGLIOSIDES

G. ROTONDO, G. MANIERO (Roma, Universita, Rome, Italy), and G. TOFFANO (Fidia Research Laboratories, Padua, Italy) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 61, Feb. 1990, p. 162-164. refs

Aircrews operating at high G forces and altitudes may be exposed to both physiological and physical stresses capable of inducting brain hypoxia. A potential therapeutic tool for the treatment of flight personnel, monosialoganglioside (GM1) has been found to reduce deficits and enhance repair following CNS injury. A survey of experimental evidence concerning the effects of GM1 in the acute phase of CNS injury supports its proposed application for aerospace medicine. Author

A90-24436
POLICY CONSIDERATIONS OF HUMAN IMMUNODEFICIENCY VIRUS (HIV) INFECTION IN U.S. NAVAL AVIATION PERSONNEL

JONATHAN B. CLARK (U.S. Navy, Naval Aerospace Medical Institute, Pensacola, FL) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 61, Feb. 1990, p. 165-168. refs

This article reviews the available medical data that form the basis for the U.S. Navy's policy on aeromedical disposition of Human Immunodeficiency Virus (HIV) seropositive flyers. Following a brief review of military HIV antibody testing and clinical evaluation, this article addresses the main issue in the Navy's aeromedical disposition policy - the subtle neurologic sequelae of HIV infection or HIV encephalopathy. Following a review of the available knowledge of HIV involvement in the nervous system, the aeromedical considerations that form the basis of Navy policy of permanently grounding without waiver all HIV seropositive flyers is discussed. Author

A90-24437* Utah Univ., Salt Lake City.
MEDICAL IMPACT ANALYSIS FOR THE SPACE STATION

BRENT D. NELSON (LDS Hospital, Salt Lake City, UT), REED M. GARDNER, DAVID V. OSTLER, JOHN M. SCHULZ, and JAMES S. LOGAN (NASA, Johnson Space Center; Krug International, Houston, TX; LDS Hospital, Salt Lake City, UT) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 61, Feb. 1990, p. 169-175. refs

(Contract NAS9-17425)

In this study, Space Station medical care priorities were determined by a medical impact analysis of two analog populations, U.S. Army and U.S. Navy personnel. Diseases and injuries in the International Classification of Disease, 9th Revision, Clinical Modification (ICD-9-CM) were ranked, using a Medical Impact Score (MIS) combining modified incidence rate and a function of disease outcome. The validity of the analysis method was tested by measuring rank order correlation between the two analog populations. Despite virtually identical age and sex distributions, Army and Navy incidence rates differed significantly for half of the ICD-9-CM categories, p less than 0.05. Disability rates differed for 76 percent, p less than 0.05. Nevertheless, Army and Navy MIS rank orders for categories and sections were not significantly different, p less than 0.001. In critical ways, the Space Station will be a safer environment than earth. Cardiac events, musculoskeletal injuries, affective psychoses, and renal calculi were among the highest scoring categories. Author

A90-24759
POSSIBILITIES OF USING FLIGHT SIMULATORS FOR CONTINUOUS MEDICAL SUPERVISION OF AIRCRAFT PERSONNEL [VOZMOZHNOSTI ISPOL'ZOVANIIA AVIATSIONNYKH TRENAZHEROV V PROTSESSE DINAMICHESKOGO VRACHEBNOGO NABLIUDENIIA ZA LETNYM SOSTAVOM]

V. A. BODROV and V. V. KHARIN Voenno-Meditsinskii Zhurnal (ISSN 0026-9050), Nov. 1989, p. 51-55. In Russian. refs

It is known that some healthy pilots subjected to psychological stress during training that involves complicated and difficult maneuvers eventually exhibit excessive emotional activity and uncoordination during real flights that include complex aircraft maneuvers or encounter adverse meteorological conditions. This paper presents data on experiments with flight simulators, designed to identify the psychophysiological mechanisms involved in the regulation and stabilization of the emotional activity of pilots engaged in flight activity, and to diagnose the disturbances of these mechanisms. Some practical recommendations for aviation physicians are given, derived from experimental findings on pilots with functional disorders of nervous and cardiovascular systems. I.S.

A90-24769
HUMANS IN SPACE - MEDICAL CHALLENGES
JAMES W. HUMPHREYS, JR. IN: Space: National programs and international cooperation. Boulder, CO, Westview Press, 1989, p. 125-134.

The biomedical aspects of human space activity are examined. An overview of the history of the study of biomedical problems associated with space flight is given. Consideration is given to determining the optimal atmosphere for the cabin of a spacecraft, the effect of microgravity on physiologic functions, the effects of radiation and isolation, and problems associated with the lack of the usual cycles of light and darkness. Also, the problems of nourishment and the elimination of body wastes are discussed. R.B.

A90-24817*# National Aeronautics and Space Administration, Washington, DC.
ARTIFICIAL GRAVITY AS A COUNTERMEASURE IN LONG-DURATION MANNED SPACE FLIGHT
JAMES W. WOLFE and FRANK M. SULZMAN (NASA, Washington, DC) IN: Space manufacturing 7 - Space resources to improve life on earth; Proceedings of the Ninth Princeton/AIAA/SSI Conference, Princeton, NJ, May 10-13, 1989. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 309-311.

The physiological problems caused by prolonged weightlessness are briefly discussed. Prolonged bed rest is examined as a simulant of prolonged microgravity exposure. The rotation of a spacecraft is considered as a menas to counteract the problems caused by prolonged weightlessness. C.D.

A90-24818#
PHYSIOLOGICAL PARAMETERS OF ARTIFICIAL GRAVITY
L. W. SCHULTHEIS (Johns Hopkins University Hospital, Baltimore, MD), M. FALLON (Jefferson University Hospital, Philadelphia, PA), G. KIEBZAK (NIH, Gerontology Research Center, Bethesda, MD; Science Applications International Corp., San Diego, CA), F. KAPLAN (Pennsylvania, University Hospital, Philadelphia), and R. BENOIT (Maryland, University, College Park) IN: Space manufacturing 7 - Space resources to improve life on earth; Proceedings of the Ninth Princeton/AIAA/SSI Conference, Princeton, NJ, May 10-13, 1989. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 312-321. refs

A suspended rat model has been developed which simulates ambulatory forces on weight-bearing bone at 0, 25, 50, 75, and 100 percent of earth gravity. Dynamic histomorphometry of rat tibias demonstrate that trabecular bone mass describes a sigmoid function of weightbearing, with a plateau at 25-75 percent weightbearing. A similar sigmoid curve describes bone formation rate as indicated by fluorescent tetracycline labels and trabecular osteoid seam width. Bone resorption is constant in rats suspended at 25-100 percent weightbearing, and significantly elevated in rats with nonweightbearing femurs. These data suggest that only about 25 percent of earth gravity may be needed to prevent metabolic bone abnormalities in spaceflight. C.D.

A90-24819#
SELECTION OF ATMOSPHERIC PRESSURE FOR A LUNAR BASE - A TRADE OFF STUDY
ANNA E. PETROPOULOS IN: Space manufacturing 7 - Space resources to improve life on earth; Proceedings of the Ninth Princeton/AIAA/SSI Conference, Princeton, NJ, May 10-13, 1989. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 332-336. refs

The results of a tradeoff study for the selection of the most appropriate atmospheric pressure level for a lunar base are reported. The factors considered include EVA norms, reduction of structural mass, quality control impacts of a lower pressure, toxicity, volatility, flammability, cooling, contamination, space debris and meteoroids, atmospheric pressure alteration, gas volume, cost projections for pressure maintenance, plans for agriculture areas and research facilities, health maintenance, and international compatibility. It is concluded that the lunar base should be maintained at an atmospheric pressure of 14.7 psi. C.D.

A90-24820*# National Aeronautics and Space Administration, Washington, DC.
SPACE IMMUNOLOGY - PAST, PRESENT AND FUTURE
GARY R. COULTER (NASA, Washington, DC), GERALD R. TAYLOR (NASA, Johnson Space Center, Houston, TX), and GERALD SONNENFELD (Louisville, University, KY) IN: Space manufacturing 7 - Space resources to improve life on earth; Proceedings of the Ninth Princeton/AIAA/SSI Conference, Princeton, NJ, May 10-13, 1989. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 337, 338. refs

Research results on the causes and mechanisms of change in immune systems during spaceflight are briefly reviewed. The most reliable conclusion from the sparse existing data is that postflight crew members exhibit a transient neutrophilia, eosinopenia, monocytopenia, reduced numbers of circulating T cells, and an often pronounced decrease in the ability of their T cells to respond to mitogen stimulation. Clinically, no direct predictive relationship between any of these measurements and increased health risk or disease has been established. Future areas of research are suggested in light of NASA's emerging requirements to support long-duration missions. C.D.

A90-26009
MOTION SICKNESS SUSCEPTIBILITY AND AEROBIC FITNESS - A LONGITUDINAL STUDY
B. S. K. CHEUNG, K. E. MONEY, and I. JACOBS (Defence and Civil Institute of Environmental Medicine, Downsview, Canada) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 61, March 1990, p. 201-204. refs

A longitudinal study evaluated the susceptibility to motion sickness in initially unfit subjects before and after an endurance training program. Motion stimulation was provided by the Precision Angular Mover in which the subject was tumbled head over heels about an earth-horizontal axis at 20 cycles per minute in darkness. Maximal aerobic power and the blood lactate response to submaximal exercise were evaluated with cycle ergometry. The training program caused significant improvements in maximal oxygen uptake and endurance capacity, and a significant decrease in percent body fat. There was a significant (p less than 0.0125) increase in motion sickness susceptibility after the physical training, suggesting that increased physical fitness caused increased susceptibility to motion sickness in some individuals. Author

A90-26011
EFFECTS OF WHOLE-BODY VIBRATION WAVEFORM AND DISPLAY COLLIMATION ON THE PERFORMANCE OF A COMPLEX MANUAL CONTROL TASK
RONALD W. MCLEOD and MICHAEL J. GRIFFIN (Southampton, University, England) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 61, March 1990, p. 211-219. refs

An experiment is described in which two independent groups of eight subjects each performed a combined continuous and discrete tracking task during exposure to vertical whole-body vibration. Both groups received sinusoidal and random vibration at preferred third-octave center frequencies of 0.5-10 Hz. One group performed the task with the display collimated by a convex lens. Without the collimation, performance was disrupted by both types of vibration at all vibration frequencies; collimation removed the disruption at frequencies above 1.6 Hz. There were differences in the effects of random and sinusoidal vibration at 2.0 and 2.5 Hz, suggesting that compensatory eye movements were assisting performance during exposure to the predictable sinusoidal motion. The results show that continuous control performance was disrupted by visual interference at frequencies above 1.6 Hz; closed-loop system transfer functions showed that visual interference increased the phase lags which impaired control performance. Possible mechanisms explaining the disruption in performance at lower frequencies are discussed. Author

A90-26012
ALTITUDE SYMPTOMATOLOGY AND MOOD STATES DURING A CLIMB TO 3,630 METERS
BARBARA SHUKITT-HALE, TERRY M. RAUCH, and RICHARD FOUTCH (U.S. Army, Research Institute of Environmental Medicine, Natick, MA) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 61, March 1990, p. 225-228. refs

The effects of an ascent to 3600-m altitude on the altitude symptomatology and mood states in humans were assessed in seven male volunteers during a period of a 7-day climb to 3600 m of Mt. Sanford, Alaska. The symptoms and moods were self-rated five times, using the Environmental Symptoms Questionnaire and the Profile of Mood States questionnaire, respectively: twice at 2225 m, then at 2530, 3080, and 3630 m. It was found that, as the ascent progressed, subjects experienced more respiratory acute mountain sickness, exertion stress, and muscular discomfort, and they were colder, less alert, less vigorous, and more fatigued than at the altitude of 2225 m. These changes occurred primarily at 3630 m, but most also occurred at 3080 m. I.S.

A90-26013
PERIODIC BREATHING AND O2 SATURATION IN RELATION TO SLEEP STAGES AT HIGH ALTITUDE
HERVE NORMAND, MARIO BARRAGAN, ODILE BENOIT, OLIVIER BAILLIART, and JEANNE RAYNAUD (Instituto Boliviano de Biologia de Altura, La Paz, Bolivia; Caen, Universite; Centre Chirurgical Marie-Lannelongue, Le Plessis-Robinson; Institut National de la Sante et de la Recherche Medicale, Paris, France) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 61, March 1990, p. 229-235. Research supported by Ministere des Relations Exterieures of France, CNRS, and Universite Paris XI. refs

This study was designed to compare sleep organization at high altitude (HA) and sea level (SL) and to estimate the extent periodic breathing (PB) negatively influences arterial O2 saturation (SaO2). Six lowlanders were studied at SL and after three weeks spent at 3800 m (La Paz, Bolivia). Three electroencephalogram leads, electrooculogram, submental electromyogram, chest and abdominal motion, temperature of ventilated gas, and SaO2 were polygraphically recorded. Comparison of HA and SL data disclosed that: (1) sleep organization was identical, with the same percentage of REM and stage 4; (2) PB occurred in three subjects during all stages of sleep except REM; and (3) during PB, SaO2 oscillated very regularly from 78-90 percent, which resulted in a mean SaO2 value calculated during oscillations similar to that of the nonperiodic breathers. It is concluded that lung O2 uptake during PB is preserved. Author

A90-26014
EFFECT OF HYPOXIA ON VO2 KINETICS DURING PSEUDORANDOM BINARY SEQUENCE EXERCISE
R. L. HUGHSON, H. C. XING, G. C. BUTLER, and D. R. NORTHEY (Waterloo, University, Canada) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 61, March 1990, p. 236-239. Research supported by NSERC. refs

The dynamic response characteristics of the oxygen uptake (VO2) response were investigated during upright cycle ergometer exercise in six healthy male volunteers, which consisted of a pseudorandom binary sequence (PRBS) with 15 units per sequence, each unit 15 sec long, for a total period of 225 sec. Each subject exercised under both normoxic and hypoxic (FIO2 = 14 percent) conditions. VO2 was measured breath-by-breath. The data were analyzed in the frequency domain by Fourier analysis to yield amplitude and phase shift coefficients for the relationship between the input work rate and the output responses of VO2 and heart rate (HR). The amplitude of the VO2/work-rate ratio was significantly reduced by hypoxia compared to normoxia over a wide range of frequencies. The mean VO2 was not different between hypoxia and normoxia. The phase shift for the VO2/work-rate response was significantly greater for hypoxia than normoxia. Author

A90-26015
CARDIOVASCULAR RESPONSE TO 4 HOURS OF 6-DEG HEAD-DOWN TILT OR OF 30-DEG HEAD-UP TILT BED REST
GARY C. BUTLER, HUACHENG XING, and RICHARD L. HUGHSON (Waterloo, University, Canada) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 61, March 1990, p. 240-246. Research supported by NSERC. refs

The cardiovascular responses to 4 h of 6-deg head-down tilt (HDT) were compared to those of 4 h of 30-deg head-up tilt (HUT) following a period of 1 h baseline in the 30-deg HUT position. Eight healthy males completed each tilt position. Immediately on assuming HDT, heart rate decreased slightly from baseline, but did not differ from HUT. Stroke volume and cardiac output both increased significantly by as much as 54 percent and 26 percent, respectively, in the first minute of HDT. The difference between HDT and HUT was no longer present after 30 min. Mean arterial blood pressure was unchanged throughout 4 h or HUT or HDT. The ratio of preinjection period to left ventricular ejection time was significantly decreased across all 4 h of HDT. Plasma volume was slightly elevated over the 4 h of HDT, while plasma hemoglobin concentration was significantly reduced. No evidence of a diuresis was found with 4 h HDT. Plasma catecholamines were not different between HDT and HUT. Author

A90-26016
THE USE OF TYMPANOMETRY TO DETECT AEROTITIS MEDIA IN HYPOBARIC CHAMBER OPERATIONS
JAMES A. DEVINE, VINCENT A. FORTE, PAUL B. ROCK, and ALLEN CYMERMAN (U.S.Army, Research Institute of Environmental Medicine, Natick, MA) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 61, March 1990, p. 251-255. refs

Diagnosis and quantification of aerotitis media were performed using a modified commercially-available tympanometer under hypobaric conditions. Subjects were 22 males and 9 females, 22-43 years of age, who were tested in each ear with the tympanometer prior to and after exposure, sequentially at the barometric pressure plateaus of 706, 656, 609, 586, 564, and 522 mm Hg, and following an induced ear block during a 1-min descent from 522 to 586 mm Hg. Each subject was examined once either alone or in pairs during a 90-min exposure. Aerotitis media was detected using tympanometry at simulated altitude as evidenced by the difference

between measurements made during induced ear blocks and those made prior to inducement, as well as following relief of the pressure differential with the Valsalva maneuver. There were no significant differences between pre- and postinduced aerotitis media values at 586 mm Hg, or between pre- and posthypobaria. The study suggests that tympanometry can be a valuable tool in managing aerotitis media in the aeromedical environment. Author

A90-26017
CLINICAL ASPECTS OF INFLIGHT INCAPACITATIONS IN COMMERCIAL AVIATION
ALAIN MARTIN-SAINT-LAURENT, JEAN LAVERNHE, GERARD CASANO, and ALAIN SIMKOFF (Air France, Paris) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 61, March 1990, p. 256-260. refs
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This study examines the causes of sudden in-flight incapacitation in Air France pilots and flight engineers from 1968-88. Ten cases were reported out of a population of 1,800 cockpit crew, each flying an average of 600 h/year. These incapacitations were due to cardiac disorders (one atrial fibrillation, one sinus tachycardia), epileptic attacks (two generalized seizures), duodenal hemorrhages (two cases), infection (one case of severe vertigo due to viral labyrinthitis), metabolic disorders (one case of hypoglycemia), and sometimes disorders affecting the whole crew (one case of hypoxia due to a pressurization deficiency, one case of CO2 intoxication caused by the inadequate packaging of a container refrigerated in dry ice). Seven times out of ten, incapacitations occurred during cruising, twice during approach, and once on the ground before starting up, with closed doors (CO2 intoxication). Two of these incapacitations led to flight diversions. In this series, incapacitations of a cardiac nature were rarer and less serious than those caused by gastrointestinal or neurological disorders. Prevention is based on detection during systematic medical check-ups, and on crews being trained to recognize subtle incapacitations early. Author

A90-26019
VOICE ANALYSIS TO PREDICT THE PSYCHOLOGICAL OR PHYSICAL STATE OF A SPEAKER
ROBERT RUIZ, CLAUDE LEGROS, and ANTONIO GUELL (Laboratoire d'Acoustique, de Metrologie et d'Instrumentation; CNES, Toulouse, France) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 61, March 1990, p. 266-271. Research supported by CNES. refs
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A vocal message, apart from its semantic content, carries information on the psychological and physiological condition of the speaker. Physical fatigue and especially psychological stress are the pathological elements of the condition. The accepted term for the cause of these effects is the 'workload'. This article describes the main research carried out since the 1940's to measure the acoustic modifications of the voice brought about by a workload. It concludes by a critical analysis of the studies and a short description of the perspectives for research. Their results mainly concern astronauts and pilots involved in specific high-stress tasks and possible users of voice recognition systems. All the studies show an excellent approach to this field of research but deserve to be widened, deepened, and made more accurate to enable estimating the nature or level of reaction to a workload. Author

A90-26124#
CHANGE IN SALIVA CORTISOL LEVEL OF F-15 FIGHTER PILOTS FLYING SEVERAL TRAINING MISSIONS
HIDEO TARUI, FUKUMI NOZAWA, FUMIKO TAJIMA, YUKIKO KAKIMOTO, and AKIO NAKAMURA Japan Air Self Defense Force, Aeromedical Laboratory, Reports (ISSN 0023-2858), vol. 29, Dec. 1988, p. 113-119. In Japanese, with abstract in English. refs

Changes in the salivary cortisol levels of F-15J fighter pilots are examined for night navigation, ground control intercept, and aerial combat maneuver (ACM) training missions. Also, +Gz changes were recorded during the ACM missions. It is found that the concentration of saliva cortisol slightly increased after the ground control intercept mission, but did not increase after night navigation. The salivary cortisol level was significantly increased after the ACM mission. The difference between the saliva cortisol response to the simulated ACM in anti-G training and the actual response during the ACM mission is discussed. R.B.

A90-26125#
THE INFLUENCE OF VISUAL CUE UPON THE CENTER OF FOOT PRESSURE (CFP) AND MUSCLE ACTIVITIES IN POSTURE CONTROL - UNDER A 1.5-DEGREE VISUAL FIELD CONDITION
NORIKO NITAMI, MIKIO ONO, and HIROSHI OSADA Japan Air Self Defense Force, Aeromedical Laboratory, Reports (ISSN 0023-2858), vol. 29, Dec. 1988, p. 121-133. In Japanese, with abstract in English. refs

The influence of visual cue on posture control is studied using subjects examined in Romberg's and Mann's posture under three types of visual conditions: open eyes, closed eyes, and a 1.5 degree visual field. The center of foot pressure power components and axis shifts were measured for both postures under the three visual conditions. R.B.

A90-26126#
RESULTS OF UPPER DIGESTIVE TRACT EXAMINATION OF PHYSICAL EXAMINATION FOR FLYING IN AGED PILOTS
MASASHI KATO and YOUSUKE SHIMAMOTO Japan Air Self Defense Force, Aeromedical Laboratory, Reports (ISSN 0023-2858), vol. 29, Dec. 1988, p. 135-141. In Japanese, with abstract in English. refs

Results are presented from the radiographic or endoscopic upper digestive tract examinations performed on pilots over 40 yrs old in Japan. Gastric ulcers, gastric cancer, and duodenal ulcers were found in 1.9, 0.1, and 3.2 percent of the 651 pilots examined in 1987. It is suggested that the incidence of duodenal ulcer in the pilots over 40 yrs old is higher than those in other populations of the same age. R.B.

A90-26243#
EFFECTS OF HEAT STRESS ON COGNITIVE AND PSYCHOMOTOR PERFORMANCE, WITH AND WITHOUT HEAD COOLING
JOHN W. GOSBEE (Wright State University, Dayton, OH; Krug International Corp., Houston, TX) and MELCHOR J. ANTUNANO (Wright State University, Dayton, OH) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 2. Columbus, OH, Ohio State University, 1989, p. 506-511. refs

Human cognitive decrements under heat stress are measured and characterized using a portable head cooling system. The skin and core temperature, heart rate, and body fluid loss of eleven subjects were measured for one hour under three different conditions: at an effective temperature of 23 C, and at an effective temperature of 33 C with and without head cooling. In the heat stress condition, the average skin temperature dropped 4.3 C, the average core temperature dropped 0.5 C, and the average body fluid loss was 350 ml. It is found that these physiological changes were improved when the head cooling system was used. It is found, however, that there is no significant difference in cognitive or psychomotor performance under the three conditions. R.B.

A90-26248#
BIOGENIC AMINES/METABOLIC RESPONSE PROFILES OF PILOTS - AN APPROACH TO STUDY PHYSIOLOGICAL RESPONSES
J. HARRIS, G. S. KRAHENBUHL, and J. R. STERN (Arizona State University, Tempe) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 2. Columbus, OH, Ohio State University, 1989, p. 533-538. Research supported by USAF and Arizona State University. refs

Results are presented from a cluster analysis of data on the urinary excretion of biogenic amine neurotransmitters and their

metabolites by USAF student pilots during training. The concentrations of several amines and metabolites in the basal state and in response to several stressor conditions are compared. It is found that biochemical stress response patterns vary with the mode of stress. It is suggested that the study demonstrates the usefulness of cluster analysis procedures for studying multicomponent chromatographic biochemical data. R.B.

A90-26293#
IS HEART RATE A VALID, RELIABLE, AND APPLICABLE INDEX OF PILOT WORKLOAD IN COMMERCIAL TRANSPORT AIRCRAFT?
S. A. METALIS, M. A. BIFERNO, and W. H. CORWIN (Douglas Aircraft Co., Long Beach, CA) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 2. Columbus, OH, Ohio State University, 1989, p. 814-819.

As part of a larger study of the validity and reliability of various workload measures for use in aircraft certification, heart period was investigated. Pilots flew either normal or high workload missions in a B-727 simulator. The results indicate that heart period as a supplemental index of workload is applicable to transport aircraft flight decks. Some sampling artifacts make a strong interpretation tenuous, but samples of 30 heartbeats proved sensitive to workload manipulations and appear to capture the phasic changes in workload better than the heart data collected from the entire measurement window. Author

A90-26320
INFLUENCE OF THE RENIN-ANGIOTENSIN SYSTEM ON HUMAN FOREARM BLOOD FLOW
CARSTEN STADEAGER, BIRGER HESSE, OLE HENRIKSEN, FLEMMING BONDE-PETERSEN, JESPER MEHLSEN (Hvidovre Hospital; Glostrup Hospital; National Hospital, Copenhagen, Denmark) et al. Journal of Applied Physiology (ISSN 0161-7567), vol. 68, Feb. 1990, p. 527-532. Research supported by Rumudvalget, Merck, Sharp og Dohme, and Leo Pharmaceutical Products. refs
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In 13 healthy Na(+)-depleted subjects the forearm blood flow (FBF) was measured by the Xe-133 washout technique; subcutaneous and muscle blood flows were determined separately. FBF was measured during supine rest, after the arm was lowered, and during lower body negative pressure (LBNP). The measurements were repeated during intra-arterial saralasin infusion in six subjects and after intravenous administration of enalapril in seven subjects. FBF decreased and forearm vascular resistance (FVR) increased during arm lowering and LBNP, as the result of local and central adrenergic reflexes, respectively. Similar FBF and FVR values were observed after both saralasin and enalapril, except for a decrease in FVR at rest after enalapril. It is concluded that, in the human forearm, angiotensin II is not necessary for sympathetic vasoconstrictor reflexes but may, through a central effect, have some influence on arteriolar tone at rest. Author

A90-26322
METABOLIC EFFECTS OF EXPOSURE TO HYPOXIA PLUS COLD AT REST AND DURING EXERCISE IN HUMANS
KEITH A. ROBINSON and EMILY M. HAYMES (Florida State University, Tallahassee) Journal of Applied Physiology (ISSN 0161-7567), vol. 68, Feb. 1990, p. 720-725. refs
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The effects of exposure of humans to hypoxia, cold, and a combination of two stressors on physiological and metabolic responses at rest and during exercise were investigated. It was found that hypoxia increased the heart rate (HR), systolic blood pressure (SBP), pulmonary ventilation, respiratory exchange ratio (R), blood lactate, and perceived exertion during exercise, while depressing rectal temperature (Tre) and oxygen uptake. The exposure to cold was found to elevate SBP, diastolic blood pressure (DBP), pulmonary ventilation, oxygen uptake, blood glucose, and blood glycerol, but to decrease HR, Tre, and R. In the combined hypoxia and cold exposure, shivering and DBP were higher and Tre was lower, compared with room-temperature hypoxia, whereas oxygen uptake and blood glycerol were depressed. I.S.

A90-26380
EEG-REACTIONS IN HUMANS TO LIGHT FLASHES OF VARIOUS FREQUENCY [EEG-REAKTSII CHELOVEKA NA PRERYVISTYE SVETOVYE VOZDEISTVIIA RAZNOI CHASTOTY]
A. I. FEDOTCHEV and A. T. BONDAR' (AN SSSR, Institut Biologicheskoi Fiziki, Pushchino, USSR) Uspekhi Fiziologicheskikh Nauk (ISSN 0301-1798), vol. 21, Jan.-Mar. 1990, p. 97-109. In Russian. refs
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The effect of intermittent light stimuli on the electric activity of the cerebral cortex is examined on the basis of published results, with special consideration given to the dependence of this effect on the frequency of light flashes and the regional and hemispheric specificity of EEG reactions to light signals with linearly increasing frequency. It is concluded that EEG reactions to flashing light are of resonant nature and that the reactions are frequency-dependent and stable, and specific with respect to the cerebral region and hemisphere. I.S.

A90-27403* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
RADIOLOGICAL HEALTH RISKS
D. STUART NACHTWEY (NASA, Johnson Space Center, Houston, TX) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 5 p. refs
(SAE PAPER 891432) Copyright

The crew of a manned Mars mission will be unavoidably exposed to galactic cosmic ray (GCR) flux. The Mars mission crew shielded by 2 g/sq cm Al could receive about 0.7 Sv in a 460-day mission at solar minimum. However, three-fourths of this dose-equivalent in free space is contributed by high LET heavy ions (Z 3 or greater) and target fragments with average Q of 10.3 and 20, respectively. Such high quality factors for these particles may be inappropriate. Moreover, in a 460-day mission, less than half of the nuclei in the body of an astronaut will have been traversed by a single heavy particle. The entire concept of absorbed dose/quality factors/dose-equivalents as applied to GCR must be reconsidered. Author

A90-27405
PERIODIC ACCELERATION STIMULATION IN SPACE
RUSSELL R. BURTON (USAF, School of Aerospace Medicine, Brooks AFB, TX) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 6 p. refs
(SAE PAPER 891434) Copyright

The need to provide acceleration in space for astronauts to prevent the physiologic debilitating effects of weightlessness termed the weightless adaptation syndrome (WAS), is discussed. The use of a short-radius 1.5-1.8 m centrifuge to provide short-duration (less than 2 hrs) periodic (perhaps daily or less frequent) exposures of 1 G or greater to prevent WAS is proposed. This approach is termed periodic acceleration stimulation in a weightless environment (PAS-WE). Four human-use studies are described that are considered necessary to validate the usefulness of PAS-WE to prevent WAS and to provide the necessary information for aerospace engineers to design and build the proper centrifuge for Space Station. Author

A90-27439* Lockheed Engineering and Sciences Co., Houston, TX.
ENABLING HUMAN EXPLORATION OF SPACE - A LIFE SCIENCES OVERVIEW
KAREN K. GAISER (Lockheed Engineering and Sciences Co., Washington, DC) and FRANK M. SULZMAN (NASA, Life Sciences Div., Washington, DC) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 6 p.
(SAE PAPER 891471) Copyright

In the transition from the short-duration missions of the Space Shuttle era to long-duration exploration missions, the health and safety of crewmembers must be ensured. The body undergoes many complex physiological changes as a result of its adaptation to a microgravity environment and U.S. and Soviet experiences have shown that time is required for readaptation to gravity. The consequences of these changes for the extended exploration missions envisioned for the future are unknown. A Mars mission may require crewmembers to spend many months in microgravity, and then work effectively in a one-third gravity environment. Other problems may arise when returning crewmembers must readapt to earth's gravity. Life Sciences activities are being planned to systematically address the physiological issues involved with long-term manned exploration missions, through ground-based studies and flight investigations on the Shuttle and Space Station Freedom. The areas of focus are artificial gravity, radiation, health care, and space human factors. Author

A90-27441
USE OF QUANTITATIVE ELECTROMYOGRAPHY (EMG) IN THE EVALUATION OF FATIGUE ASSOCIATED WITH PRESSURE GLOVE WORK
PAUL A. FURR, JOHN M. O'HARA, MICHAEL BRIGANTI (Grumman Space Systems, Bethpage, NY), and SERGE ROY (Boston University, MA) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 8 p. refs
(SAE PAPER 891473) Copyright

Noninvasive EMG was used to evaluate fatigue of the finger flexors, thumb flexor, and wrist extensor muscles associated with hand work. The 1000 series pressure suit glove was used in conjunction with a glove box testing methodology. Determination of the degree of muscle fatigue was based on an analysis of the change in the median frequency of the EMG associated with bare-hand, gloved-hand/0 psid and gloved-hand/4.3 psid work. The methodology for collecting EMG data and the analysis of the median frequency as a physiological means of quantifying muscle fatigue is presented. The intent of this program was to develop objective means of analyzing hand performance for any pressure glove design, and compare it to bare-hand performance. Author

A90-27454* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
PRELIMINARY ANALYSES OF SPACE RADIATION PROTECTION FOR LUNAR BASE SURFACE SYSTEMS
JOHN E. NEALY, JOHN W. WILSON, and LAWRENCE W. TOWNSEND (NASA, Langley Research Center, Hampton, VA) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 12 p. refs
(SAE PAPER 891487) Copyright

Radiation shielding analyses are performed for candidate lunar base habitation modules. The study primarily addresses potential hazards due to contributions from the galactic cosmic rays. The NASA Langley Research Center's high energy nucleon and heavy ion transport codes are used to compute propagation of radiation through conventional and regolith shield materials. Computed values of linear energy transfer are converted to biological dose-equivalent using quality factors established by the International Commision of Radiological Protection. Special fluxes of heavy charged particles and corresponding dosimetric quantities are computed for a series of thicknesses in various shield media and are used as an input data base for algorithms pertaining to specific shielded geometries. Dosimetric results are presented as isodose contour maps of shielded configuration interiors. The dose predictions indicate that shielding requirements are substantial, and an abbreviated uncertainty analysis shows that better definition of the space radiation environment as well as improvement in nuclear interaction cross-section data can greatly increase the accuracy of shield requirement predictions. Author

A90-27457
POTENTIAL FOR REDUCTION OF DECOMPRESSION SICKNESS BY PREBREATHING WITH 100 PERCENT OXYGEN WHILE EXERCISING
JAMES T. WEBB, JANET F. WIEGMAN (Krug International Corp., San Antonio, TX), and GENE A. DIXON (USAF, School of Aerospace Medicine, Brooks AFB, TX) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 6 p. refs
(Contract F33615-85-C-4503; F33615-89-C-0603)
(SAE PAPER 891490) Copyright

Exercise performed for at least 30 min while prebreathing 100 percent oxygen prior to decompression has been reported to increase efficiency of denitrogenation by 100-500 percent. The incidence of decompression sickness following such a prebreathe was decreased by 50 percent compared to resting prebreathe. This article provides background and recommends parameters for a test to determine the operational feasibility of prebreathing with exercise. Author

A90-27509
DECOMPRESSION SICKNESS RISKS FOR EUROPEAN EVA
LORENZ VOGT, JUERGEN WENZEL (DLR, Institut fuer Flugmedizin, Cologne, Federal Republic of Germany), STEPHEN LUCK (Dornier GmbH, Friedrichshafen, Federal Republic of Germany), and BENGT SVENSSON (ESTEC, Noordwijk, Netherlands) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 10 p. refs
(SAE PAPER 891546) Copyright

The design of a European space suit with a design pressure of 500 hPa requires a reevaluation of the protective procedures for space-suit decompression. An R factor of 1.2 and a tissue half-time of 360 minutes in a single-tissue model have been identified as appropriate operational values. On the basis of an acceptable risk level of approximately 1 percent, oxygen prebreathing times are proposed for (1) direct pressure reduction from 1013 hPa to a suit pressure of 500 hPa and (2) staged decompression using a 700-hPa intermediate stage in the spacecraft cabin. In addition, factors which influence individual susceptibility to DCS are identified. Author

A90-27555
MEDICAL GUIDELINES FOR PROTECTING CREWS WITH FLAME-SUPPRESSANT ATMOSPHERES
DOUGLAS R. KNIGHT (U.S. Navy, Naval Submarine Medical Research Laboratory, Groton, CT) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 7 p. Research supported by the U.S. Navy. refs
(SAE PAPER 891596) Copyright

General guidelines for each of three proposed modifications of sea-level air are presented. The flame hazard can be reduced by lowering the oxygen concentration although excessive modification of the atmosphere can cause a number of medical problems: hypoxia, barotrauma, nitrogen narcosis, or decompression sickness. These conditions establish the basic medical criteria for designing habitable atmospheres to reduce the flame hazard of fires. Experimental evidence supports the use of 130-torr oxygen to design habitable, flame-suppressant atmospheres. It is concluded that life-support systems and medical technology allow the design and operational use of habitable, flame-suppressant atmospheres. R.E.P.

N90-17253# Florida Univ., Gainesville. Dept. of Psychology.
AUDITORY PATTERN MEMORY: MECHANISMS OF TONAL SEQUENCE DISCRIMINATION BY HUMAN OBSERVERS
Annual Report, 1 Oct. 1988 - 31 Oct. 1989
ROBERT D. SORKIN 31 Oct. 1989 17 p
(Contract AF-AFOSR-0021-89; AF PROJ. 2313)
(AD-A214494; AFOSR-89-1349TR) Avail: NTIS HC A03/MF A01 CSCL 06/4

A series of experiments testing the discrimination of random temporal patterns (single frequency tone sequences) was performed. The observer's task was to discriminate whether two

sequences of tones contained the same or different patterns of temporal gaps. Half of the experimental trials contained gap sequences that were perfectly correlated across the two sequences (e.g., the temporal patterns were identical), and half the trials contained gap sequences that were partially correlated (the correlation was controlled by adding the outputs of two normal deviate generators). A model of discrimination, based on computation of the sample correlation between the gaps, and limited by a fixed source of internal (independent) temporal noise, allowed good prediction of observer performance. Some additional sources of variance were due to encoding or memory limitations. The correlation model makes specific predictions about the consequences of sequence time compression and expansion on performance; experiments are under way to evaluate the effects of these transformations. GRA

N90-17254# Army Aeromedical Research Lab., Fort Rucker, AL. Biodynamics Research Div.
SIMULATOR SICKNESS IN THE AH-1S (COBRA) FLIGHT SIMULATOR Final Report
DANIEL W. GOWER, JR. and JENNIFER FOWLKES (Essex Corp., Orlando, FL.) Sep. 1989 78 p
(Contract DA PROJ. 3E1-62777-A8-79)
(AD-A214562; USAARL-89-20) Avail: NTIS HC A05/MF A01 CSCL 06/10

Field studies of operational flight simulators were conducted to assess the incidence and severity of simulator sickness. Simulator sickness here refers to the constellation of motion sickness related symptoms that occur in simulators due to visual representation, motion base representation, or combination of the two representations of flight. The incidence rates and relative frequency of specific symptoms are presented. Correlational factors such as recent simulator experience, current state of health, overall flight experience, mission scenario, and flight dynamics are presented. The Army's flight simulators are ranked in comparison to the 10 Navy simulators studied by the Naval Training Systems Center, Orlando, FL. The need is reinforced for studies to understand perceptual rearrangement, adaptation/readaptation, and pilot susceptibility to the effects of simulation. Design criteria for simulators, as well as those training guidelines necessary to cope with this phenomenon also must be addressed. GRA

N90-17255# Army Aeromedical Research Lab., Fort Rucker, AL. Sensory Research Div.
EVALUATION OF TWO OBJECTIVE MEASURES OF EFFECTIVE AUDITORY STIMULUS LEVEL
TED L. LANGFORD, BEN T. MOZO, and JAMES H. PATTERSON, JR. Aug. 1989 28 p
(AD-A214669; USAARL-89-18) Avail: NTIS HC A03/MF A01 CSCL 06/16

The brainstem auditory evoked response and the 40-Hz component of the auditory mid-latency response were measured in human subjects as a function of stimulus frequency and level to determine whether one of the two could be used to provide a reliable estimation of the amount of attenuation provided by hearing protective devices in situations in which the time available for measurement is restricted. Under the conditions of the present experiment, the variability of the data for both types of measure was too great to permit a reliable estimation of effective stimulus level. Potentially harmful noise levels in many military environments require the use of hearing-protective devices by personnel operating in those environments. A rapid, reliable, and valid method for the field measurement of the amount of attenuation afforded by the various hearing protectors is needed to ensure that the devices are being properly used and are effective in reducing noise exposure. At present, a method for objectively measuring the attenuation of hearing protectors in a field environment is not available. GRA

N90-17256# Naval Aerospace Medical Research Lab., Pensacola, FL.
A REVIEW OF CIRCADIAN EFFECTS ON SELECTED HUMAN INFORMATION PROCESSING TASKS Interim Report
DIANE L. DAMOS 3 Apr. 1989 37 p
(AD-A214673; NAMRL-MONOGRAPH-37) Avail: NTIS HC A03/MF A01 CSCL 06/4

This monograph examines the magnitude of circadian effects on selected information processing tasks. The monograph begins with a brief discussion of the statistical and methodological problems associated with assessing circadian effects. The remainder of the monograph reviews the pertinent literature. Each study is described briefly first and critically examined from a methodological standpoint. Then, the maximum and minimum circadian effects are presented as a percentage of mean performance to allow the results to be compared across studies. Approximately half of the statistical tests conducted to detect circadian effects were nonsignificant. The majority of circadian effects, regardless of their statistical significance, showed less than a 10 percent difference between mean performance and either the maximum or minimum performance. GRA

N90-17257# Naval Aerospace Medical Research Lab., Pensacola, FL.
IDENTIFYING THE CIRCADIAN CYCLE IN HUMAN INFORMATION PROCESSING DATA USING PERIODICITY ANALYSIS: A SYNOPSIS Interim Report
DIANE L. DAMOS 3 Apr. 1989 9 p
(AD-A214674; NAMRL-TM-89-1) Avail: NTIS HC A02/MF A01 CSCL 06/4

Data from human information processing tasks frequently cannot satisfy the assumptions of many common periodicity techniques. This memorandum identifies appropriate techniques for data that cannot meet all of the assumptions of the more familiar ones. GRA

N90-17258# Defence Research Establishment Atlantic, Dartmouth (Nova Scotia). Research and Development Branch.
HUMAN FACTORS IN THE NAVAL ENVIRONMENT: A REVIEW OF MOTION SICKNESS AND BIODYNAMIC PROBLEMS
JAMES L. COLWELL Sep. 1989 70 p
(AD-A214733; DREA-TM-89/220) Avail: NTIS HC A04/MF A01 CSCL 06/10

Two types of motion-induced problems affecting human performance in the naval environment are reviewed; motion sickness and biodynamic problems. Methods for predicting the incidence of motion sickness are described and evaluated, and problems associated with modeling complex motions are discussed. References for quantifying habituation are cited and methods for defining the severity of motion sickness symptoms are described. Biodynamic problems are briefly discussed, including the low-frequency, large-amplitude problems of motion-induced interruptions (MII) and fatigue; and the higher-frequency problems of manual control and vision. Methodologies and criteria for evaluating human performance within the systems approach to seakeeping assessment are discussed and topics for future work are recommended. GRA

N90-17259# Human Systems Div., Brooks AFB, TX.
ENVIRONMENTAL QUALITY AND OCCUPATIONAL HEALTH SPECIAL EMPHASIS AREA PLAN (SEAP) Final Report, Sep. 1988 - May 1989
JOHN C. BONNIN and RICHARD B. DRAWBAUGH Jun. 1989 24 p
(AD-A214738; HSD-SR-89-019) Avail: NTIS HC A03/MF A01 CSCL 06/14

The Deputy for Development Planning, Human Systems Division, is tasked with performing studies and analyses to identify future requirements in the areas of crew protection and aerospace medicine, crew system integration, force readiness, and environmental protection. This special Emphasis Area Plan (SEAP) focuses on the functional area of environmental protection, identifying systems and enabling technologies needed to support the goals of Air Force environmental programs. This SEAP also lists Air Force Systems Command programs related to these systems and technologies and assesses the time frame and criticality of each technology relative to the system it supports.

Systems discussed include hazardous material identification and toxicity evaluation systems, cost modeling systems, improved industrial hygiene and waste minimization systems, environmental monitoring technology evaluation systems, and simulation and testing facilities, risk analysis and cost projection systems, and long term environmental planning systems. Enabling technologies include biologically based toxicity computer modeling, rapid toxicity screening, tiered approach to toxicity testing, artificially intelligent expert toxicology system, combustion toxicology standards, hydraulic fluids toxicology studies, standards for evaluating engineering trade-offs, cost models, and analysis methods. GRA

N90-17260# University of Central Florida, Orlando.
THE EFFECTS OF FOVEAL LOAD ON PERIPHERAL SENSITIVITY IN THE VISUAL FIELD Final Report
EDWARD J. RINALDUCCI Oct. 1989 39 p
(Contract DAAL03-87-K-0014)
(AD-A214872; ARO-24828.1-LS) Avail: NTIS HC A03/MF A01 CSCL 06/4

The main objective of this research was to investigate the effects of foveal load on sensitivity in the peripheral visual field. In the first of a series of four experiments, foveal load was manipulated by comparing the fixation of a cross vs. a simple first-order compensatory tracking task display. Peripheral sensitivity was determined simultaneously for light flashes presented at different eccentricities along the horizontal meridian. In general, the results showed no losses in peripheral sensitivity or a tunnel vision effect under the experimental conditions employed. In the three subsequent experiments, more complex tracking tasks were employed in order to vary foveal load. The difficulty of the perimetry task has also been manipulated in the fourth experiment by including lights on the vertical, as well as the horizontal meridian. Whether or not a loss or a gain in peripheral sensitivity was obtained depended upon the complexity of the foveal task and to some extent the difficulty of the perimetry task. Results are discussed in terms of arousal and resource theory, and recommendations are made for future research in this area. GRA

N90-17261# Naval Medical Research Inst., Bethesda, MD.
STATISTICALLY BASED DECOMPRESSION TABLES 5: HALDANE-VANN MODELS FOR AIR DIVING Final Report, Jan. 1987 - Nov. 1988
Y. J. PARSONS, P. K. WEATHERSBY, S. S. SURVANSHI, and E. T. FLYNN Feb. 1989 64 p
(AD-A214934; NMRI-89-34) Avail: NTIS HC A04/MF A01 CSCL 06/10

The analysis is continued of air decompression diving by probabilistic models evaluated using the statistical tool of maximum likelihood. Models based on the traditional deterministic calculations of Haldane have been placed in a probabilistic formalism by Vann. The ability of these models to fit data examined in the first and fourth reports in the present series were explored here. The computationally simpler Haldane-Vann (H-V) models achieved comparable success fitting relatively homogeneous data to the risk models used in the earlier reports in this series. However, H-V models were unable to deal successfully with larger and more diverse collections of data. It appears that the Vann definition of decompression dose intrinsically cannot lead to simultaneously successful predictions of both short and long air dives. GRA

N90-17262# Air Force Systems Command, Wright-Patterson AFB, OH. Foreign Technology Div.
THE CHARACTERISTICS OF PHYSIOLOGICAL RESPONSES AND TOLERANCE EVALUATION OF PRESSURE BREATHING
JINGSHAN CHEN, BAOLAN ZHANG, and SIGUANG JIA 12 Oct. 1989 18 p Transl. into ENGLISH from Acta Aeronautica et Astronautica Sinica (Peoples Republic of China), v. 10, no. 2, Feb. 1989 p 59-65 Original language document was announced in IAA as A89-39476
(AD-A214991; FTD-ID(RS)T-0827-89) Avail: NTIS HC A03/MF A01 CSCL 06/4

Experiments were performed on 6 young healthy males during pressure breathing without trunk counter-pressure. The values of intra-pulmonary pressure used were 0, 2.0, 3.0, 3.4, 4.0, 4.4 and 5.4 kPa. The results were summarized as follows. With the increase of pressure within the lung, the compensatory functions of circulatory and respiratory power consumption index was increased, but it was dropped as the intra-pulmonary pressure reached 4.0 kPa. The decrease of above objective physiological indices showed that the compensatory function was weakened, which was the indication of physiological endurance limit during pressure breathing. There was a serious subjective symptom for the breathing to be continued difficulty experimental examples discontinued only, that maybe considered as the acceptable endurance index. The respiratory power consumption index can reflect respirodynamically physiological characteristics of subjective sensation in human during pressure breathing which may be used as a co-indicator for the evaluation of the tolerance of pressure breathing was presented through the experiment. The intra-pulmonary pressure of 2.0, 3.4, and from 4.0 to 6.2 kPa was considered to be the physiological limit of safety, allowance and endurance. This study denoted marked significance for establishing physiological standard and protective measure of pressure breathing by oxygen. GRA

N90-17263# NSI Technology Services Corp., Dayton, OH.
PROCEEDINGS OF THE 17TH CONFERENCE ON TOXICOLOGY Interim Report
Sep. 1989 424 p Conference held in Dayton, OH, 3-5 Nov. 1987
(Contract F33615-85-C-0532; AF PROJ. 6302)
(AD-A215076; AAMRL-TR-89-027; NMRI-89-58) Avail: NTIS HC A18/MF A03 CSCL 06/11

This series of manuscripts from the 17th Conference on Toxicology addresses critical research and development issues for quantitatively assessing the health risks associated with various occupational and environmental exposures. To meet the needs of the Department of Defense, these contributions focus on the current knowledge of quantitative methods in toxicology especially as applied to military systems or military operations. These manuscripts present state-of-the-art methodologies that will improve our ability to develop objective indices of toxicity keeping in mind that the ultimate purpose is to predict expected human toxicity. GRA

N90-17264# Army Research Inst. of Environmental Medicine, Natick, MA.
TEMPERATURE REGULATION DURING UPPER BODY EXERCISE: ABLE BODIED AND SPINAL CORD INJURED
MICHAEL N. SAWKA, WILLIAM A. LATZKA, and KENT B. PANDOLF Apr. 1989 34 p
(Contract DA PROJ. 3M1-6287-A-879)
(AD-A215130) Avail: NTIS HC A03/MF A01 CSCL 06/10

This paper will consider human thermoregulatory response differences between upper and lower body exercise. In addition, the thermoregulatory problems of spinal cord injured individuals are examined. For able-bodied individuals, the rise in core temperature is independent of the skeletal muscle mass employed and dependent upon the metabolic rate during exercise. The avenues of heat exchange, however, are different for individuals performing upper body and lower body exercise. During upper body exercise, there is a greater dry heat loss from the torso, however, no additional heat loss (as compared to lower body exercise) occurs from the exercising arms. If an individual performs upper body exercise in cold water, he/she will lose a greater amount of heat and be more susceptible to hypothermia than during lower body exercise. A spinal cord injury will impair man's ability to thermoregulate because of: (1) loss of vasomotor and sudomotor control to the areas of the insensate skin; (2) a reduced thermoregulatory effector response for a given core temperature; and (3) a loss of skeletal muscle pump activity from the paralyzed limbs. GRA

N90-17265# Army Research Inst. of Environmental Medicine, Natick, MA.
PRE-TREATMENT WITH TYROSINE REVERSES HYPOTHERMIA INDUCED BEHAVIORAL DEPRESSION
T. MICHAEL RAUCH and HARRIS R. LIEBERMAN (Massachusetts Inst. of Tech., Cambridge.) Sep. 1989 20 p
(AD-A215211) Avail: NTIS HC A03/MF A01 CSCL 06/15

Cold exposure accelerates the firing frequency of norepinephrine (NA) neurons, enhancing NA release and leading to NA depletion in specific regions of the brain. The accelerated firing activates the enzyme tyrosine-hydroxylase, making it more tyrosine sensitive. The reduction of brain NA is accompanied by a behavioral depression on the open field test. Two experiments were performed on adult male rats. First, it was determined whether systematic lowering of core body temperature produced behavioral depression in the swim test. Second, treatment with the NA precursor tyrosine was employed in an attempt to prevent hypothermia-induced behavioral depression. In experiment 1, two levels of hypothermia were highly effective in producing behavioral depression in rats forced to swim in a narrow cylinder containing water. In experiment 2, treatment with tyrosine (400 mg/kg, ip) thirty minutes prior to the hypothermia procedure completely reversed the behavioral depression found in experiment 1. Tyrosine administration did not significantly influence the rate of deep body cooling during the hypothermia treatment. GRA

N90-17266# Army Research Inst. of Environmental Medicine, Natick, MA.
SENSATIONS OF TEMPERATURE AND HUMIDITY DURING INTERMITTENT EXERCISE AND THE INFLUENCE OF UNDERWEAR KNIT STRUCTURE
RUTH NIELSEN (National Inst. of Occupational Health, Solna, Sweden) and THOMAS L. ENDRUSICK Sep. 1989 22 p
(AD-A215285) Avail: NTIS HC A03/MF A01 CSCL 06/10

In occupational as well as recreational outdoor activities, intermittent exercise is common. In autumn and winter, a varying activity level may easily result in periods of sweating and chilling. In these situations, thermoreceptors are of significance for automatic temperature regulation, and for conscious sensation of the temperature of the body and of the actual environment. The sensitivity to thermal stimuli varies between the core and different body surface areas. Humans have no humidity receptors, but in some way the wetness of the skin is also sensed, and can be related to the evaluation of comfort and discomfort. Also, the clothing worn generates thermal and contact wearing sensations. The purpose was to investigate the development of various subjective temperature and humidity sensations of the body, of the skin-clothing interface, and of the environment in dressed subject's during intermittent exercise in an environment resulting in both periods of sweating and chilling. Further, we aimed to study the significance of the knit structure in underwear during the course of the subjective sensations, and whether there was any correlation between subjective sensations and physiological/physical observations. GRA

N90-17267# Army Research Inst. of Environmental Medicine, Natick, MA. Exercise Physiology Div.
EFFECTIVENESS OF PROGRESSIVE RESISTANCE TRAINING FOR INCREASING MAXIMAL REPETITIVE LIFTING CAPACITY
MARILYN A. SHARP, EVERETT A. HARMAN, BRIAN E. BOUTILIER, MATTHEW W. BOVEE, and WILLIAM J. KRAEMER 27 Oct. 1989 27 p
(AD-A215286) Avail: NTIS HC A03/MF A01 CSCL 05/9

The purpose was to investigate the effects of 12 weeks of progressive resistance training on the performance of a high intensity repetitive lifting task. The repetitive lifting task consisted of lifting a 41 kg box to a chest high shelf as many times as possible in 10 min. Subjects were randomly assigned to a training (TR) or a control group (CT). The TR group (n=18) participated in progressive resistance training 3 times each week for 12 weeks. The CT group (n=7) was asked to maintain their current exercise habits which did not include progressive resistance training. Repetitive lifting task performance and one repetition maximum strength for box lift, bench press, deadlift and squat were recorded before and after progressive resistance training. Improvement in the strength of the training group was significantly greater (p less than .05) than that of the CT group. The increase in strength was accompanied by greater change (p less than .05) in repetitive lifting task performance for the training group (pre-test = 79.1 lifts, post-test = 92.4 lifts) than the CT group (pre-test = 84.9 lifts, post-test = 82.0 lifts). It is concluded that traditional progressive resistance training exercises are effective in improving performance of an occupational lifting task. Regular progressive resistance training can be particularly important in maintaining the effectiveness of manual workers in jobs that require high intensity lifting on an infrequent basis. GRA

N90-17268# Naval Biodynamics Lab., New Orleans, LA.
GUIDELINES FOR SAFE HUMAN EXPOSURE TO IMPACT ACCELERATION, UPDATE A
MARC S. WEISS, DAVID L. MATSON, and STEPHEN T. MAWN 1 Sep. 1989 16 p
(AD-A215287; NBDL-89R003) Avail: NTIS HC A03/MF A01 CSCL 06/10

Tolerance levels for living human volunteers are defined and developed for minimum risk injury. The experimentally safe levels of impact, derived from a variety of sources, are suggested as guidelines for torso-restrained volunteers, where the freely moving head and neck are the anatomical segments most at risk. These recommended limits are no greater than the maximum exposures already experienced by Naval Biodynamics Laboratory's volunteers. No injuries have been sustained at these levels. GRA

N90-17269# Johns Hopkins Univ., Laurel, MD. Applied Physics Lab.
STRUCTURAL ALTERATIONS IN THE CORNEA FROM EXPOSURE TO INFRARED RADIATION Final Report, 1 Apr. 1986 - 14 Apr. 1988
R. A. FARRALL, R. L. MCCALLY, C. B. BARGERON, and W. R. GREEN Aug. 1989 31 p
(Contract DA PROJ. 3E1-62787-A8-78)
(AD-A215340) Avail: NTIS HC A03/MF A01 CSCL 06/10

Research is summarized for the interaction of infrared radiation, especially from high-intensity CO2 TEA lasers, with the cornea. The research reported here was performed between April 1, 1986 and April 14, 1988. The threshold epithelial damage from single- and multiple-pulse exposures, material ejection from the anterior corneal surface, lesion histology, and possible damage mechanisms are discussed. GRA

N90-17270# Naval Submarine Medical Center, Groton, CT.
WORKSHOP ON THE EFFECTS OF COMBINED FIRE PRODUCTS ON HUMAN PHYSIOLOGICAL AND PSYCHOLOGICAL PERFORMANCE Final Report, period ending Nov. 1987
A. B. CALLAHAN, C. A. HARVEY, and C. H. POHLER (Naval Sea Systems Command, Washington, DC.) 9 Aug. 1989 12 p
Workshop held in Groton, CT, 16-18 Nov. 1987
(AD-A215465; NSMRL-SP89-4) Avail: NTIS HC A03/MF A01 CSCL 06/4

This report summarizes the discussion and conclusions reached at a Workshop on the Effects of Combined Fire Products on Human Physiological and Psychological Performance. The workshop was held at the Naval Submarine Medical Research Laboratory on 16 to 18 Nov. 1987. GRA

N90-17271# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
AN EXPLORATORY ANALYSIS OF MOTION SICKNESS DATA: A TIME SERIES APPROACH M.S. Thesis
DAVID C. THOMPSON Dec. 1989 151 p
(AD-A215534; AFIT/GSO/EMS/89D-15) Avail: NTIS HC A08/MF A01 CSCL 06/10

A methodology was developed in order to characterize the prodigious amount of electroencephalographic (EEG) data collected during motion sickness experiments at the Air Force Institute of

Technology. The analog data are sampled and digitized into a time series. Stationarity transformations and a windowing operation are performed on the data to produce local areas of stationarity. Windowed versions of the autocorrelation function, partial autocorrelation function and periodogram are discussed and employed. The windows are analyzed over time in order to view the underlying structure of the model that is hidden in the data. These functions are converted into image files to aid interpretation. The images are directly interpreted for model determination, model changes, artifact assessment and stationarity determination. A primary subject and two confirming subjects are analyzed. Both a placebo trial and Dilantin trial were analyzed for each subject to determine the nature of motion sickness and the efficacy of the drug treatment. The results are inconclusive as all three subjects brain data proved to be unique with respect to the placebo trials. GRA

N90-17272# Army Research Inst. of Environmental Medicine, Natick, MA.

PSYCHOLOGICAL AND PHYSIOLOGICAL RESPONSES OF BLACKS AND CAUCASIANS TO HAND COOLING Final Report, Sep. 1985 - Jun. 1989

RONALD L. JACKSON, DONALD E. ROBERTS, RANDY A. COTE, PATRICK MCNEAL, and JANET T. FAY Jun. 1989 57 p
(AD-A215646; USARIEM-T20-89) Avail: NTIS HC A04/MF A01 CSCL 06/10

The factors contributing to the susceptibility of Blacks and Caucasians to cold sensitivity are investigated. Control measurements were taken for 10 minutes in room air for 112 male subjects (52 Blacks and 60 Caucasians), 18 to 41 years of age. Immediately following the control period, one hand was immersed for 20 minutes in 5 C, stirred cold water. Cardiovascular responses and hand blood flow (BF) were monitored once every minute. Middle finger temperature (Tmf) of the immersed and non-immersed hands was measured every 30 sec. Before cold water immersion, Tmf was higher for Caucasians than Blacks. During 20 minutes of cold water immersion, Tmf remained significantly higher in Caucasians compared to Blacks. Lower Tmf in Blacks may be a result of a greater sympathetic response to the cold water stress as noted by the heart rate, blood pressure, and non-immersed BF values during the initial minutes of cold water immersion. Data from this study support previous reports that peripheral cold sensitivity is greater in Blacks when compared to Caucasian individuals of similar age and physical characteristics. Another possible determinant of finger temperature during the cold water immersion test as demonstrated in this study was the level of prior cold weather experience (CE) an individual possessed. Tmf was dependent on level of CE to a greater degree than geographic origin alone. GRA

N90-17273# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.

A CEPSTRAL ANALYSIS OF EEG (ELECTROENCEPHALOGRAPHIC) SIGNALS IN MOTION SICKNESS STUDIES M.S. Thesis

RUSSEL B. SMITH Dec. 1989 83 p
(AD-A215663; AFIT/GSO/ENG/89D-1) Avail: NTIS HC A05/MF A01 CSCL 06/10

Electroencephalographic (EEG) signals were studied during the evolution of motion sickness. Cepstral transformation techniques and hypothesis testing were used to investigate the relationships between phenytoin serum levels and malaise period EEG signals. The same techniques were used to study the relationships between phenytoin-malaise period EEG signals and placebo-malaise period EEG signals. The relationships between pre-malaise period EEG signals for phenytoin and placebo trials were also studied. Eighteen male subjects were given the drug phenytoin in a double-blind, placebo-controlled crossover experiment. Subjects were rotated in a motion chair while eight physiological parameters were measured. Although the drug delayed or prevented the onset of emesis, no statistically significant relationships were found between phenytoin serum levels and frontal-midline EEG signals. GRA

N90-17274# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.

MEASUREMENT OF THE IMPULSE RESPONSE OF THE HUMAN VISUAL SYSTEM USING CORRELATION TECHNIQUES M.S. Thesis

EDWARD A. COLLEY Dec. 1989 66 p
(AD-A215667; AFIT/GE/ENG/89D-8) Avail: NTIS HC A04/MF A01 CSCL 06/5

Random signal testing techniques are applied to the human visual system. A binary maximal length sequence was used to modulate a fluorescent light bank by about 15 percent. With this pseudo-random noise as a visual input, subjects were monitored with an electroencephalograph (EEG). The cross correlation between the pseudo-random input and the EEG output yields an estimate of the subject's visual system impulse response. An attempt was made to verify the impulse response using matched filter theory. GRA

N90-17612# Rouen Univ. (France). Lab. de Toxicologie.

METHOD FOR THE EVALUATION OF TOXICITY OF COMBUSTION PRODUCTS FROM AIRCRAFT CABIN MATERIALS: ANALYSIS AND RESULTS [METHODE D'EVALUATION DE LA TOXICITE DES PRODUITS DE THERMOLYSE DES MATERIAUX DE CABINE AVION ANALYSE DES RESULTATS]

J. M. JOUANY and M. FAVAND (Centre d'Essais Aeronautique Toulouse, France) *In* AGARD, Aircraft Fire Safety 8 p Oct. 1989 In FRENCH
Copyright Avail: NTIS HC A18/MF A03; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

In order to aid in the selection of aircraft cabin materials, an experimental method was developed for the evaluation of toxic decomposition products from burning materials. The complete methodology combines a fire model and an experimental procedure that permits, on the one hand, an assessment of the material combustion reaction in terms of physico-chemical factors (weight loss, flammability, heat emission, and emission of fumes) and, on the other hand, an analysis of combustion product toxicity in terms of biological factors measured in mice (incapacitation and mortality). Methods for the statistical multivariate analysis of the collected data (principal components analysis) are discussed and a technique for the classification of materials is proposed. Transl. by M.G.

N90-17617# Royal Air Force Inst. of Pathology and Tropical Medicine, Aylesbury (England).

THE INVESTIGATION OF PARTICULATE MATTER IN THE LUNGS OF SMOKE INHALATION DEATH VICTIMS

I. R. HILL and B. P. MICHELSON *In* AGARD, Aircraft Fire Safety 9 p Oct. 1989
Copyright Avail: NTIS HC A18/MF A03; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

Although the mechanisms involved in the causation of injury and death, due to the inhalation of the products of combustion are incompletely understood, the potential hazard is well recognized and was, at least in part, for many year. The response to smoke and toxic fume inhalation are many and varied, and include airway obstruction, bronchitis, atalectasis, pneumonitis, and respiratory failture. Damage to the cilia in the upper respiratory tract and to respiratory macrophages, may cause changes in the pulmonary defence mechanisms, which may in turn predispose to lung infection. The Manchester Airport Boeing 737 accident in 1985, and subsequently a series of domestic fires, have refocused lay interest in the various hazards. Insofar as house fires are concerned, 30 people died when soft furnishings were the first item ignited in 1962; 20 years later 152 people died. Research workers in various countries have long expressed an interest in this problem and there was considerable expenditure of effort and resources, in attempts to fully understand the mechanisms involved. Unfortunately contrary views still persist and this has its effects upon attempts to understand mechanisms and to propose logical solutions, which will improve the safety of the environment

in fires. The literature and the results of some microscopical studies of the victims of fires investigated in an attempt to explain some of the observed phenomena. Author

N90-17618# Royal Albert Edward Infirmary, Wigan (England).
THE IMPORTANCE OF PATHOPHYSIOLOGICAL PARAMETERS IN FIRE MODELLING OF AIRCRAFT ACCIDENTS
JOHN S. S. STEWART *In* AGARD, Aircraft Fire Safety 12 p Oct. 1989
Copyright Avail: NTIS HC A18/MF A03; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

The importance of pathophysiological parameters in fire modeling of aircraft accidents was under estimated. Pathological and toxicological studies and survivors' evidence all indicate rapid incapacitation by kerosene smoke. A combination of anoxic and stagnant anoxia can explain the evidence. Incapacitation by smoke is the important event which leads to death from cyanide and carbon monoxide poisoning. Fire blocking and fire hardening, although useful in some limited situations, are largely irrelevant to real accidents involving fatalities. Fire models which purport to establish a safety benefit, on the sole basis of escape time to flashover, are far too simplistic. Much more weight should be given to protective breathing equipmemt and to water spray systems. Author

N90-17619# Huntingdon Research Centre Ltd. (England).
MODELLING TIME TO INCAPACITATION AND DEATH FROM TOXIC AND PHYSICAL HAZARDS IN AIRCRAFT FIRES
DAVID A. PURSER *In* AGARD, Aircraft Fire Safety 13 p Oct. 1989
Copyright Avail: NTIS HC A18/MF A03; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

Studies of incapacitation and lethality in laboratory animals and human fire victims, resulting from exposure to thermal decomposition products from many materials, indicate two main mechanisms of toxicity, narcosis (asphyxia) and irritancy. Narcotic effects are caused by the common asphyxiant gases, CO, HCN, low O2, and CO2 and can be predicted to a reasonable degree with existing knowledge. Irritant effects are caused by a variety of combustion products some of which are unknown, but can be quantified from small scale rodent combustion toxicity tests in terms of the mass loss concentration of combustion products using an index of respiratory tract irritation, and an index of lethality, in mg/min/liter. A mathematical model is presented for estimating toxic and physical hazard in fire in terms of time to incapacitation or death. The model takes the concentration/time profiles of the above products, smoke optical density, temperature and radiant heat flux (derived from other mathematical models of aircraft fires or large scale fire tests) and calculates time to incapacitation using a Fractional Effective Dose method based upon the known toxic effects to the combustion products, and of the physical hazards, in man, primates and rodents. Author

N90-18135# Human Engineering Labs., Aberdeen Proving Ground, MD.
EFFECT OF CONTRALATERAL MASKING PARAMETERS ON DIFFERENCE LIMEN FOR INTENSITY Final Report
LESLIE J. PETERS Sep. 1989 81 p
(Contract DA PROJ. 1L6-1102-B7-4A)
(AD-A214169; HEL-TM-11-89) Avail: NTIS HC A05/MF A01 CSCL 23/2

The effect of narrow band and wide band contralateral masking using different overall sound pressure levels (SPL) on a difference limen (threshold) for intensity task was investigated. Specifically, the narrow band of masking was created by passing white noise through a 1/10 octave filter. The wide band of masking was created by passing this noise through a 1/3 octave filter. The results indicated that: contralateral masking influenced a subject's ability to detect small changes in intensity. These masking effects did not change significantly (p is less than 0.5) from day 1 to day 2 of the experiment. When the overall SPL was changed by 6 dB and the bandwidth held constant at either 277 or 926 Hz, no significant difference was discovered in the ability to detect small incremental intensity changes. When the masking bandwidth were varied and the overall SPL was held constant, a significant difference occurred. The wide band masking conditions were all more sensitive than the narrow bandwidths with the same SPL. When the bandwidth and the overall SPL of the contralateral masker were varied, a significant difference occurred. The experiment demonstrated that the wide band masker appeared to widen the ipsilateral critical band at 4000 Hz and that this pattern held for the four levels (30, 36, 50, 56 dB) of wide band masking presented. GRA

N90-18136* National Aeronautics and Space Administration, Washington, DC.
AEROSPACE MEDICINE AND BIOLOGY: A CONTINUING BIBLIOGRAPHY WITH INDEXES (SUPPLEMENT 333)
Feb. 1990 53 p
(NASA-SP-7011(333); NAS 1.21:7011(333)) Avail: NTIS HC A04; NTIS standing order as PB89-912300, $10.50 domestic, $21.00 foreign CSCL 06/5

This bibliography lists 122 reports, articles and other documents introduced into the NASA Scientific and Technical Information System during January, 1990. Subject coverage includes: aerospace medicine and psychology, life support systems and controlled environments, safety equipment, exobiology and extraterrestrial life, and flight crew behavior and performance. Author

N90-18137* National Aeronautics and Space Administration, Washington, DC.
AEROSPACE MEDICINE AND BIOLOGY: A CONTINUING BIBLIOGRAPHY WITH INDEXES (SUPPLEMENT 331)
Jan. 1990 55 p
(NASA-SP-7011(331); NAS 1.21:7011(331)) Avail: NTIS HC A04; NTIS standing order as PB89-912300, $10.50 domestic, $21.00 foreign CSCL 06/5

This bibliography lists 129 reports, articles and other documents introduced into the NASA Scientific and Technical Information System during December, 1989. Subject coverage includes: aerospace medicine and psychology, life support systems and controlled environments, safety equipment, exobiology and extraterrestrial life, and flight crew behavior and performance. Author

N90-18138# Dayton Univ., OH.
SAFETY EVALUATION OF INFRARED LAMP POWER OUTPUT FOR OCULOMETER EYE/HEAD TRACKER SYSTEM Final Report, Sep. 1988 - Sep. 1989
R. J. EVANS and J. C. GAINER (Air Force Human Resources Lab., Williams AFB, AZ.) Dec. 1989 33 p
(Contract F33615-87-C-0012)
(AD-A215809; AFHRL-TP-89-63) Avail: NTIS HC A03/MF A01 CSCL 17/5

The Air Force is concerned about the possible long-term effects of radiation used to illuminate the eye for eye tracking purposes. Toward this purpose, measurements were taken to determine the power output of the halogen lamp from the oculometer of the Honeywell (Type YG1784AO1) head and eye tracker used at the Air Force Human Resources Laboratory, Operations Training Division (AFHRL/OT), Williams AFB, Arizona. Radiation from the lamp (General Electric Lamp No. 784, Emergency Lighting - Halogen) is projected through the optics of the helmet onto the user's eye. The returned or reflected signal from the pupillary region of the eye is subsequently analyzed to determine eye position. A thermopile was placed behind a small aperture at the eye position inside the helmet in order to measure the amount of radiation at the eyepoint. Output of the halogen lamp varied with input current where minimum and maximum operational currents were .8 and 1 ampere. Irradiance measurements recorded using the thermopile were .20 milliwatts/sq cm for an .8-amp input and .55 mW/sq cm for a 1-amp input. These reading were determined

to be well within safety standards currently set by industry. However, it is suggested that ocular exposure to such radiation be minimized, as more research is required in order to ascertain chronic effects resulting from long-term exposure of the eye to low levels of radiation. GRA

N90-18139# California Univ., Irvine. Center for the Neurobiology of Learning and Memory.
ACETYLCHOLINESTERASE INHIBITION AND INFORMATION PROCESSING IN THE AUDITORY CORTEX Final Report, 1 Apr. 1985 - 31 Dec. 1988
NORMAN M. WEINBERGER 17 Aug. 1989 52 p
(Contract DAMD17-85-C-5072; DA PROJ. 3M1-61102-BS-11)
(AD-A216092) Avail: NTIS HC A04/MF A01 CSCL 06/15

The goal of this project is to determine the effects of anticholinesterases on the processing of information in the auditory cortex. Cholinergic agonists, blockers and anticholinesterases were applied to the auditory cortex of the cat via multibarrel micropipettes, while the discharges of single neurons to calibrated acoustic stimuli were recorded. Muscarinic agonists modified neuronal responses to sound in highly specific ways rather than producing a global change in response. Muscarinic agonists modified frequency-receptive fields, including shifts in the receptive field to new best frequencies and both increases and decreases in frequency selectivity. Agonist effects were dose-dependent and could be blocked by atropine. Application of the anticholinesterases eserine and soman produced the same type of effects except that the effects of soman are considerably exaggerated and permanent within the recording period possible for single neurons. This action profoundly disturbs the encoding and representation of information. Proposed means for central nervous system protection or therapy against anticholinesterases should be assayed by the highly sensitive receptive field analysis used here. Finally, we formulated a cholinergic model of cortical information processing which explains how endogenous acetylcholine (ACh) is essential for normal cortical information processing and memory, forming a foundation for understanding anticholinesterase disruption of processing. GRA

N90-18140# Naval Medical Research Inst., Bethesda, MD.
USE OF SELF-INDUCED HYPNOSIS TO MODIFY THERMAL BALANCE DURING COLD WATER IMMERSION Final Report, Oct. 1988 - Apr. 1989
K. D. MITTLEMAN, T. J. DOUBT, and M. GRAVITZ Oct. 1989 34 p Sponsored by Naval Medical Research and Development Command, Bethesda, MD
(AD-A216156; NMRI-89-59) Avail: NTIS HC A03/MF A01 CSCL 06/10

This study was designed to evaluate the efficacy of self-induced post-hypnotic suggestion to improve physical and thermogenic responses to two cycles of alternating rest and exercise during head-out immersion in 25 C water. Twelve U.S. Navy divers volunteered to participate in two immersions conducted at the same time of day but spaced one week apart. The first immersion (control) was conducted prior to hypnotic training sessions on mental imagery and post-hypnotic suggestion techniques. There were no differences in rates of heat production, heat loss or net thermal balance between control and hypnotic conditions for the grouped values. Hypnotic susceptibility, evaluated prior to the immersions, was not significantly correlated with the change in thermal balance or rectal temperature measurements evaluated between control and hypnotic immersions. Although the rating of perceived exertion during both exercise phases were similar for both immersions, subjects' perceived thermal sensation was reduced during the second rest phase of the hypnotic immersions when compared with the control immersion. Although the majority of subjects did not exhibit a hypnotic-induced alteration in thermoregulatory responses during immersion, 3 individuals seemed to respond to hypnosis, but in a manner that accentuated heat loss. These results suggest that the post-hypnotic training techniques employed in the present study did not enhance performance in divers during immersion in 25 C. GRA

N90-18141# Boston Univ., MA. Center for Adaptive Systems.
VISUAL PERCEPTION OF STRUCTURE FROM MOTION Annual Technical Report, 1 Nov. 1988 - 31 Oct. 1989
JAMES T. TODD 20 Nov. 1989 6 p
(Contract AF-AFOSR-0016-89; AF PROJ. 2313)
(AD-A216416; AFOSR-89-1785TR) Avail: NTIS HC A02/MF A01 CSCL 06/4

The research performed by James Todd during the past year of AFOSR support has examined the ability of human observers to perceive various aspects of a moving object's 3-D structure from minimal apparent motion sequences. This research has provided a strong body of evidence that the perceptual analysis of 3-D structure from motion is apparently restricted to first order temporal relations. That is to say, when all other factors are optimized, perceptual performance does not improve as the number of discrete frames in an apparent motion sequence is increased beyond two. This research has been accompanied, moreover, by a theoretical analysis of the particular properties of 3-D structure that can be computed from first order temporal relations. The analysis makes specific predictions about which tasks can or cannot be performed accurately by human observers, and these predictions are in strong agreement with the psychophysical data. GRA

N90-18142# Naval Health Research Center, San Diego, CA.
PSYCHOPHYSIOLOGICAL CORRELATES OF HUMAN ADAPTATION IN ANTARCTICA Interim Report
L. A. PALINKAS, E. K. GUNDERSON, and R. G. BURR 1989 34 p
(AD-A216679; NHRC-89-5) Avail: NTIS HC A03/MF A01 CSCL 05/8

Previous research has pointed to social, psychological, and occupational characteristics of Antarctic station personnel as contributing to variations in emotional symptoms commonly experienced during the prolonged isolation of the winter-over period. However, little is known of the influence of specific personality characteristics and the severity of the station environment, either independently or in combination, on these symptoms. This paper examines the social, psychological, and environmental correlates of the psychophysiological symptoms associated with wintering-over in Antarctica and the extent to which these correlates can be used to predict the severity of symptomatology during the winter-over period. Station latitude, altitude, mean annual temperature, were associated with depression and insomnia at the beginning of winter and depression, hostility, and anxiety at the end of the winter. Environmental severity was a independent predictor of hostility and anxiety at the end of winter. Except for insomnia, however, the more severe the environment, the less severe the symptoms. Age was inversely associated with depression and anxiety at the beginning of winter and hostility throughout the winter. Results indicate some form of adaptation to environmental conditions appears to be taking place with respect to psychophysiological symptoms. GRA

N90-18143# New York Univ. Medical Center. Dept. of Psychiatry.
COMPUTING WITH NEURAL MAPS: APPLICATION TO PERCEPTUAL AND COGNITIVE FUNCTIONS Annual Report, 8 Jan. 1988 - 31 Jul. 1989
ERIC SCHWARTZ 24 Oct. 1989 5 p
(Contract AF-AFOSR-0275-88; AF PROJ. 2313)
(AD-A216689; AFOSR-89-1826TR) Avail: NTIS HC A01/MF A01 CSCL 05/8

During the past year, we have completed two important steps in our program for understanding the biological and computational significance of patterns of spatial mapping in the brain. First, we have found a simple algorithm which is capable of describing and synthesizing the patterns of ocular dominance columns and orientation columns in the cat and monkey. This algorithm is controlled by a small number of parameters, and we show that it produces patterns which are similar to those in our lab, and elsewhere, obtained from animal experimentation. Moreover, we show that a number of previously published algorithms for similar purposes can be shown to be equivalent to our algorithm. The

significance of this work is that we can now describe and synthesize some of the major architectural features of cat and monkey sensory cortex with high accuracy. In addition, we have obtained some insight into the essential simplicity of these patterns. This work is currently in press in Biological Cybernetics. In addition, we have developed an algorithm for pattern recognition based on the multiple, parallel two-dimensional mapping of the input data. We view this as an important step in our goal of developing insight into the use of multiple, parallel sensory mappings in the brain. We believe that this algorithm is the first pattern recognition algorithm to make explicit use of the kind of data format which is characteristic of the brain. GRA

N90-18144# Naval Medical Research Inst., Bethesda, MD.
ALTERATIONS IN THE METABOLIC AND SYMPATHETIC RESPONSE TO COLD EXPOSURE AFTER COLD AIR ACCLIMATION Technical Report, Oct. 1985 - Sep. 1993
R. L. HESSLINK, JR., D. W. ARMSTRONG, III, K. KOWALSKI, L. D. ALLEN, and H. L. REED, II 11 Dec. 1989 25 p Sponsored by Naval Medical Research and Development Command, Bethesda, MD
(AD-A216817; NMRI-89-93) Avail: NTIS HC A02/MF A01
CSCL 06/4

The armed services, primarily the Navy and Coast Guard, are tasked with maintaining free passage and security in many geographical locations encompassing tropical and polar conditions. While personnel performance in heat has been well studied and ameliorative guidelines implemented, little is known about performance and survival in the cold. Acute cold exposure elicits frank shivering concomitant with a short-term elevation in basal metabolism. Extended cold exposure can produce mild to severe hypothermia resulting in reduced cognitive function and manual dexterity, thus, having a tremendous effect on mental and physical performance. Moreover, personal safety and health can be compromised in such environments. The ability to adapt to these cold climates and possibly improve one's performance has been extensively investigated. There is strong evidence that localized cold adaptation can occur over many years of exposure. Whether this adaptation is due to local factors, central factors, or both is not clear. The mechanism responsible for whole body cold adaptation is not clearly understood, but it is generally believed that various types of whole body cold adaptation are possible. Serum triiodothyronine (T3) is the primary hormone involved with many thermoregulatory and adaptive phenomena. GRA

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BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

A90-24431* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
TRENDS AND INDIVIDUAL DIFFERENCES IN RESPONSE TO SHORT-HAUL FLIGHT OPERATIONS
THOMAS R. CHIDESTER (NASA, Ames Research Center, Moffett Field, CA) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 61, Feb. 1990, p. 132-138. refs
(Contract NCC2-286)
Copyright

A survey of airline pilots was undertaken to determine normative patterns and individual differences in mood and sleep during short-haul flight operations. The results revealed that over the course of a typical 2-d trip, pilots experience a decline in positive mood, or activity, and an increase in negative mood, or tension. On layovers, pilots report experiencing sleep of shorter duration and poorer quality than at home. These patterns are very similar to those reported by Gander and Graeber (1987) and by Gander et al. (1988), using high-fidelity sleep and activity monitoring equipment. Examination of the impact of two personality dimensions extracted from the Jenkins Activity Survey measure of the Type A personality, Achievement Striving and Impatience/Irritability, suggested that Impatience/Irritability may serve as a marker of individuals most likely to experience health-related problems on trips. Achievement Striving may serve as a predictor of performance in crew settings. Author

A90-25025* University of Southern California, Los Angeles.
A DYNAMIC MODEL OF STRESS AND SUSTAINED ATTENTION
P. A. HANCOCK (Southern California, University, Los Angeles, CA) and JOEL S. WARM (Cincinnati, University, OH) Human Factors (ISSN 0018-7208), vol. 31, Oct. 1989, p. 519-537. refs
(Contract NCC2-379)
Copyright

Arguments are presented that an integrated view of stress and performance must consider the task demanding a sustained attention as a primary source of cognitive stress. A dynamic model is developed on the basis of the concept of adaptability in both physiological and psychological terms, that addresses the effects of stress on vigilance and, potentially, a wide variety of attention-demanding performance tasks. The model provides an insight into the failure of an operator under the driving influences of stress and opens a number of potential avenues through which solutions to the complex challenge of stress and performance might be posed. I.S.

A90-25472
MODULATION OF THE MOTION AFTEREFFECT BY SELECTIVE ATTENTION
AVI CHAUDHURI (Salk Institute for Biological Studies, San Diego, CA) Nature (ISSN 0028-0836), vol. 344, March 1, 1990, p. 60-62. Research supported by NIH. refs
Copyright

In the phenomenon called motion aftereffect, a person seeing a moving visual pattern for a period of time sees the same pattern appearing to drift in the opposite direction after the visual stimulus is stopped. It is reported here that, if observers are engaged in a separate discrimination task superimposed on a moving textured background, the subsequent motion aftereffect to the background is considerably reduced. It appears that motion aftereffects are susceptible to attentional mechanisms. C.D.

A90-25996#
PILOT-VEHICLE ANALYSIS OF MULTIAXIS TASKS
DUANE MCRUER (Systems Technology, Inc., Hawthorne, CA) and DAVID K. SCHMIDT (Purdue University, West Lafayette, IN) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 13, Mar.-Apr. 1990, p. 348-355. Previously cited in issue 22, p. 3633, Accession no. A87-50539. refs
(Contract F33615-85-C-3610)
Copyright

A90-26122#
A STUDY ON MEASURING MENTAL WORKLOAD. II - MENTAL LOAD AND SALIVARY CORTISOL LEVEL
YUKIKO KAKIMOTO, HIDEO TARUI, AKIO NAKAMURA, and YUKO NAGASAWA Japan Air Self Defense Force, Aeromedical Laboratory, Reports (ISSN 0023-2858), vol. 29, Dec. 1988, p. 85-98. In Japanese, with abstract in English. refs

The effect of mental load on performance and salivary cortisol levels was tested using the Sternberg memory task as the primary mental load and an auditory discrimination task as a secondary task. Salivary cortisol level responded to increased mental load, but the response did not correlate with graded levels of mental workload. Feelings of fatigue, stress, irritation, and shoulder tightness increased in direct correlation with the graded mental load. Subjects with high 'degree of effort' scores showed high levels of salivary cortisol, while those with low scores showed relatively low changes of salivary cortisol. The results suggest that the change of salivary cortisol level is not influenced directly

and is not as sensitive to mental load as to the change of performance of mental tasks. R.B.

A90-26123#
PSYCHOLOGICAL STUDY ON MOOD STATES OF ALTITUDE CHAMBER PERSONNEL BEFORE THEIR CHAMBER MISSION
MIYAKO OKAUE and ZENJI TAKASHIMA Japan Air Self Defense Force, Aeromedical Laboratory, Reports (ISSN 0023-2858), vol. 29, Dec. 1988, p. 99-111. In Japanese, with abstract in English. refs

The moods of six personnel supporting altitude chamber flight trainees were examined. The trainees were exposed to the physiological effects of pressure change and hypoxia and were taught how to prevent decompression sickness. Questionnaires were given to the subjects before and after training. It is found that the mood states were more unstable before missions that were perceived as more difficult. The stress experienced by the subjects is evaluated using Cattel's Anxiety Scale. R.B.

A90-26176
INTERNATIONAL SYMPOSIUM ON AVIATION PSYCHOLOGY, 5TH, COLUMBUS, OH, APR. 17-20, 1989, PROCEEDINGS. VOLUMES 1 & 2
RICHARD S. JENSEN, ED. (Ohio State University, Columbus) Symposium sponsored by the Ohio State University and Association of Aviation Psychologists. Columbus, OH, Ohio State University, 1989, p. Vol. 1, 521 p.; vol. 2, 492 p. For individual items see A90-26177 to A90-26309.

Current research in aeronautical human factors is reviewed. Topics discussed include training, simulation, cockpit technology, expert systems, pilot judgment, communication, physiology, cockpit resource management, pilot reliability, rotorcraft human factors, pilot selection, visual perception, workload, accident investigation, ATC human factors, and performance assessment. B.J.

A90-26178*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
PERFORMANCE EVALUATION IN FULL-MISSION SIMULATION - METHODOLOGICAL ADVANCES AND RESEARCH CHALLENGES
THOMAS R. CHIDESTER, BARBARA G. KANKI (NASA, Ames Research Center, Moffett Field, CA), and ROBERT L. HELMREICH (Texas, University, Austin) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 1. Columbus, OH, Ohio State University, 1989, p. 16-21. refs

The crew-factors research program at NASA Ames has developed a methodology for studying the impact of a variety of variables on the effectiveness of crews flying realistic but high workload simulated trips. The validity of investigations using the methodology is enhanced by careful design of full-mission scenarios, performance assessment using converging sources of data, and recruitment of representative subjects. Recently, portions of this methodology have been adapted for use in assessing the effectiveness of crew coordination among participants in line-oriented flight training. Author

A90-26179*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
CREW WORKLOAD-MANAGEMENT STRATEGIES - A CRITICAL FACTOR IN SYSTEM PERFORMANCE
SANDRA G. HART (NASA, Ames Research Center, Moffett Field, CA) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 1. Columbus, OH, Ohio State University, 1989, p. 22-27.

This paper reviews the philosophy and goals of the NASA/USAF Strategic Behavior/Workload Management Program. The philosophical foundation of the program is based on the assumption that an improved understanding of pilot strategies will clarify the complex and inconsistent relationships observed among objective task demands and measures of system performance and pilot workload. The goals are to: (1) develop operationally relevant figures of merit for performance, (2) quantify the effects of strategic behaviors on system performance and pilot workload, (3) identify evaluation criteria for workload measures, and (4) develop methods of improving pilots' abilities to manage workload extremes. Author

A90-26180#
A REVIEW OF AIRLINE SPONSORED AB INITIO PILOT TRAINING IN EUROPE
NEIL JOHNSTON IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 1. Columbus, OH, Ohio State University, 1989, p. 33-38.

The type of ab initio (zero time) training course in which graduates proceed directly from basic training to immediate copilot duties with a major air carrier is presented. This type of training is well established in Europe and recent trends indicate a growing interest in the concept throughout the world. After reviewing the training standards of pilot training it is concluded that full time ab initio training for airlines becomes a process of total immersion in all aspects of flying. The needs of the airline remain paramount throughout this process. Attention is given to the following components of ab initio training: (1) provision of comprehensive and highly integrated training; (2) training to a combined State and airline specification; (3) training to beyond basic State and ICAO requirements; (4) extensive use of simulation, especially at the final stages of advanced training; (5) early introduction to the needs of multicrew operations; (6) training directed at the development of desirable airline attributes and career-oriented professional skills; and (7) regular and rigorous evaluation of all parts of the training system. R.E.P.

A90-26181#
TRAINING FOR SITUATIONAL AWARENESS
DOUGLAS SCHWARTZ (FlightSafety International, Inc., Houston, TX) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 1. Columbus, OH, Ohio State University, 1989, p. 44-54.

Situational awareness is defined here as the accurate perception of the factors and conditions that affect an aircraft and its flight crew during a specific period of time. The principal elements of situational awareness are listed and described as: (1) experience and training, (2) physical flying skills, (3) spatial orientation, (4) health and attitude, and (5) cockpit management, integrating in a systematic manner all of the factors contributing to situational awareness. It is pointed out that situational awareness is a major element that differentiates human error from excellence in aviation. Situational awareness is established and maintained through good cockpit management. The skills that contribute to good cockpit management can be learned and practiced. They apply in varying degrees to all pilots, regardless of their type of aircraft or style of operation. It is concluded that cockpit management training should be included in any flight training program. R.E.P.

A90-26182#
ANALYZING KNOWLEDGE DEFICIENCIES IN PILOT PERFORMANCE
ROBERT O. BESCO (Professional Performance Improvement, Inc., Lakewood, CA) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 1. Columbus, OH, Ohio State University, 1989, p. 61-86. refs

The paper examines the need to explore the reasons behind the lack of knowledge when evidence is observed that a flight crew is unable to cope with a survivable situation. The causes of knowledge inaccuracies in aircraft accidents are multiple interactions of several factors. A tested effective methodology of asking questions in a systematic fashion that will contribute to minimizing knowledge deficiencies is detailed. It is noted that the task of understanding the causes and minimizing the recurrence of knowledge inadequacies is formidable, and is further complicated by the interrelationship between knowledge, skills, attitudes, obstacles to performance, and systems environment. R.E.P.

A90-26184#
TRAINING FOR ADVANCED COCKPIT TECHNOLOGY AIRCRAFT
HARRY W. ORLADY (Orlady Associates, Los Gatos; Battelle Aviation Safety Reporting System Office, Mountain View,. CA) and WILLIAM A. WHEELER (Battelle Human Affairs Research Center, Seattle, WA) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 1. Columbus, OH, Ohio State University, 1989, p. 91-96.

Following the introduction of advanced cockpit technology (ADVTECH) aircraft, NASA requested the Aviation Safety Reporting System (ASRS), and others in the aviation community, to determine pilot opinion on the overall safety of new-generation aircraft in day-to-day line operations. In response to this request ASRS surveyed a group of pilots who flew ADVTECH aircraft in regular service and who had reported incidents. The pilots interviewed clearly supported a general industry consensus that training practices had not kept up with advancing cockpit technology. This study reviews preliminary findings on (1) training for crew coordination and communication with ADVTECH aircraft and (2) maintenance of flying skills in ADVTECH aircraft. Preliminary results indicate that there have been definite improvements in the quality of ADVTECH training since these aircraft were introduced. However, some training methods seem more effective than others, and there is room for improvement. R.E.P.

A90-26187#
DEVELOPING COCKPIT RESOURCE MANAGEMENT TRAINING CURRICULA FOR AB INITIO AIRLINE PILOT TRAINING
TOM SAMS (American Airlines, Inc., Fort Worth, TX) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 1. Columbus, OH, Ohio State University, 1989, p. 112-117. refs

The history of cockpit resource management (CRM) as it has emerged from the fields of aviation safety and human factors is reviewed. Nonstandardization of CRM objectives, lack of a CRM media pool, and other training priorities within the aviation industry have contributed to this difficulty. The economics of CRM training program development, curriculum changes, and training opportunity make the CRM issue difficult to resolve. Many questions remain regarding training methods and effectiveness. It is suggested that the potential gains in CRM proficiency through the undergraduate educational process, and existing collegiate aviation programs leading to professional pilot careers can provide the foundation of CRM attitudes for their students. It is believed that curriculum changes to facilitate these CRM objectives are well within the control of most academic institutions. R.E.P.

A90-26190#
TRANSFER OF LANDING SKILLS IN BEGINNING FLIGHT TRAINING
GAVAN LINTERN, JEFFERSON M. KOONCE, LEON D. SEGAL (Illinois, University, Savoy), and STANLEY N. ROSCOE (ILLIANA Aviation Sciences, Las Cruces, NM) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 1. Columbus, OH, Ohio State University, 1989, p. 128-133. refs
(Contract N00014-87-K-0435)

Beginning flight students were given two sessions of landing practice in a simulator with a computer-animated contact-landing display before they commenced intensive landing practice in the aircraft. For each experimental student there was a control student, paired with the same instructor, who did not receive any landing practice in the simulator. Experimental students required significantly fewer presolo landings in the airplane than the paired controls, for a potential saving of about 1.5 presolo flight hours per student. These data show that pretraining with a relatively simple and inexpensive computer-animated landing display can offer worthwhile savings in flight time, and there was evidence of incremental transfer attributable to adaptive display augmentation. Author

A90-26192#
TRANSFER OF SIMULATED INSTRUMENT TRAINING TO INSTRUMENT AND CONTACT FLIGHT
MARK G. PFEIFFER, JEFFREY D. HOREY, and STEVEN BUTRIMAS (U.S. Navy, Naval Training Systems Center, Orlando, FL) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 1. Columbus, OH, Ohio State University, 1989, p. 149-154. refs

This paper seeks to determine whether simulated instrument training transfers differentially to instrument and contact flight, in a subsonic center-line thrust jet aircraft, for undergraduate military student pilots. Test results show that there was equal transfer of training from instruments to both types of flight after eight simulator trials. Additionally, the findings indicate that the type of flight following simulator training, contact or instrument, does not make much difference for the maneuvers studied. However, the tests sampled only two types of flight maneuvers. While validity of simulation was high, there was also a tendency for students to fly the simulator with greater precision than the aircraft during the transition stage. R.E.P.

A90-26193#
FLIGHT INSTRUCTOR TRAINING AS THE FOUNDATION OF AB INITIO PILOT TRAINING
IRENE HENLEY (Newcastle, University, Australia) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 1. Columbus, OH, Ohio State University, 1989, p. 161-166. refs

The quality of flight instructor training in Canada and Australia is examined. Very little research has been devoted to assessing the quality of civil flight instructor training, and to finding ways of maximizing the instructor's effectiveness in flight training. Questionnaires were sent to a stratified sample of flight instructors and inspectors in order to evaluate the quality of flight instructor training, and the methods used in the evaluation of flight instructors, and the training needs of flight instructors and inspectors. Results corroborate previous findings that, in general, the whole teaching approach to flight training, including flight instructor training, is based on a flawed approach to teaching. This is accentuated by the fact that the teachers of flight instructors do not receive any training to prepare them to teach flight instructor trainees how to instruct. It is suggested that flight training needs to take advantage of the advances made in related fields, such as educational psychology and adult education. R.E.P.

A90-26194#
AN EVALUATION OF INTEGRATED COMMERCIAL FLIGHT TRAINING
MICHAEL J. ROSS (Newcastle, University, Australia) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 1. Columbus, OH, Ohio State University, 1989, p. 167-172.

Factors are examined which influenced student performance on and attitudes to an integrated commercial pilot training course. Analyses were designed to identify valid relationships between manifest variables such as personality factors, attitudes, and intellectual abilities, and outcome variables such as flying and academic performance on course, and instructor assessment of student performance. Three causal models are developed to accomplish this survey. Results suggest that the critical factors leading to the achievement of a commercial pilot's license in minimumum hours are: good verbal abilities, a personality suited to a more regimented and structured environment, several years' work experience earning an average salary, few doubts about coping with the course, and a positive attitude toward the learning environment. Factors leading to high instructor ratings include: good verbal and spatial abilities, dominant, tolerant, social, and achievement oriented personality style, and positive views toward the learning environment. R.E.P.

A90-26195#
A COMPARISON OF AN INTEGRATED INSTRUMENT/PRIVATE PILOT AND AN ACCELERATED INSTRUMENT FLIGHT TRAINING PROGRAM
HENRY L. TAYLOR, SYBIL PHILLIPS, RICKY A. WEINBERG, ROBERT H. KAISER, and OMER BENN (Illinois, University, Savoy) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 1. Columbus, OH, Ohio State University, 1989, p. 173-178. refs

The FAA has approved a flight training program that consists of a two-semester sequence of instruction leading to a private pilot certificate and of an additional four-semester sequence leading to a commercial pilot certificate with instrument rating. This paper evaluates the tests conducted to determine the efficacy of the courses. Results indicate that a combined contact/instrument flight training program with substantial concentration of instrument procedures at the beginning of training is effective. A comparison of the three studies shows that the one-semester concentrated combined course is more effective than either the two-semester or the four-semester course sequence. R.E.P.

A90-26196#
DUAL-CAREER MILITARY RESERVE AIRCREWMEMBERS - HUMAN FACTORS IMPACT ON AVIATION SAFETY
JANET M. KAMER and LESTER A. NATHAN IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 1. Columbus, OH, Ohio State University, 1989, p. 179-184.

The unique stressors associated with the dual-career lifestyle of military reserve aircrews are examined, in order to suggest ways in which safety, morale, and medical care can be improved. In the aviation environment, stress coping occurs in three major areas: life stress management, preflight fitness to fly, and in-flight stress coping. Within each of these major areas, five factors have been identified which materially influence safe decision making: (1) the pilot, including physical stress, physiological stress, and psychological stress, (2) the aircraft, (3) the environment, (4) the operation, and (5) the situation. This survey is intended to identify the factors cited which materially influence safety performance in the judgment of the aircrews. Responses to the detailed questionnaires are summarized and they indicate that greater involvement for family members, greater involvement on the part of flight surgeons, improving organizational efficiency, and improvements in aircraft maintenance and safety reporting are all areas that can be addressed by military command leadership. R.E.P.

A90-26197#
SOME EFFECTS OF CONSISTENCY IN TRAINING FOR AUTOMATIC INFORMATION PROCESSING
ERIC D. NADLER (Pennsylvania, Clarion University, Clarion) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 1. Columbus, OH, Ohio State University, 1989, p. 185-190. refs

An investigation is conducted and the results analyzed on the effects of partially consistent performance on seven dependent variables that have been used as converging operations for the identification of 'automaticity'. These included: decreased response time, flattening of the slope that relates response time to the number of items to be searched, exhaustive search, minimal decrement under memory load, difficulty in response to an anticipated auditory interrupt signal, decrement due to target-distractor reversal, and decreased retention of the training symbols. It is concluded that there appear to be advantages to consistency in the interface between the training system and trainee even when it is impossible to provide complete consistency and efficient training for all of the characteristics of 'automatic' information processing to occur. R.E.P.

A90-26198#
A Q-SORT ASSESSMENT OF FLIGHT INSTRUCTION AS AN OCCUPATIONAL CHOICE BY B.S. DEGREE SEEKING AVIATION STUDENTS - PROGRESS REPORT
S. R. WIERSTEINER and R. A. BUCKINGHAM (Indiana State University, Terre Haute) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 1. Columbus, OH, Ohio State University, 1989, p. 191-196. refs

The perceptions of flight instruction as a career field as expressed by freshman flight students is assessed. These students are viewed as holding few, if any, preconcieved attitudes about becoming certified flight instructors (CFI) after completing their basic flight instruction. The examination of perceptions of CFI as an occupation was conducted through the use of the sorting of cards (Q-sorts) technique and the correlations among the responses of the subjects to the Q-sorts. Concern for one's welfare, quality time, freedom, self-worth, and goal-reaching appeared paramount to the respondents. Though self-centeredness as an overall characteristic was the root psychological motivation, it is seen not as selfishness on the part of the respondents but as a concern for a quality personal life. R.E.P.

A90-26200#
USE OF FLIGHT SIMULATORS TO INVESTIGATE THE EFFECTS OF ALCOHOL AND OTHER DRUGS ON PILOT PERFORMANCE. II
DANIEL MORROW, JEROME YESAVAGE (Stanford University, CA), and MR. VON LEIRER (Decision Systems, Stanford, CA) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 1. Columbus, OH, Ohio State University, 1989, p. 203-208. refs

The following predictions are tested: (1) alcohol impairs a pilot's ability to follow air traffic control instructions, (2) age also impairs communication-based pilot performance, (3) age and alcohol cumulatively impair communication-based performance, with older pilots more impaired. Both young and older pilots were subjected to flight scenarios. Alcohol impairment was found to be greater for older pilots and also age and marijuana cumulatively impair pilot performance. These results suggest that both alcohol and age impair performance in part, by reducing working memory capacity and by increasing the chances of serious communication errors during flight. R.E.P.

A90-26204#
INTEGRATION OF A LOW COST PART TASK TRAINER (ADVANCED TRAINING DEVICE - ATD) INTO A FLIGHT CREW DEVELOPMENT PROGRAM
ROGER B. CROSTHWAITE (Massey University, Palmerston North, New Zealand) and JAMES N. SPARK (Civil Air Training Academy, Cessnock, Australia) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 1. Columbus, OH, Ohio State University, 1989, p. 227-232. refs

A training strategy is developed to reduce costs and improve learning efficiency for flight crews. Replicating an aircraft to a high level of fidelity is unnecessary in some stages of development. Evidence suggests that high fidelity may be redundant to skill acquisition in some training phases. Focusing on the needs of the learner is essential so that optimum operational competency can be developed. The rationale of this approach is that practice of part task components as a prelude to performance of complex tasks will improve whole task performances. Many tasks can be learned better, faster, and more economically in a controlled learning environment such as a groundbased trainer. It is concluded that there is little additional advantage in using an aircraft during some phases of training. R.E.P.

A90-26210*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
HEADING CONTROL AND THE EFFECTS OF DISPLAY CHARACTERISTICS
STEPHANIE J. HINZ and C. THOMAS BENNETT (NASA, Ames Research Center, Moffett Field, CA) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 1. Columbus, OH, Ohio State University, 1989, p. 263-268. refs

The present study evaluates whether type of display (dot or wire frame) and direction of movement have an effect on a person's ability to actively maintain a specific heading angle. The questions addressed were: (1) does the magnitude of the heading angle errors differ in the two displays, (2) are some heading angles more difficult to maintain than others, and (3) does the magnitude of some errors differ as a function of display type and direction of movement. Differences between the results of this study and previous research are explained by methodological differences across the studies. Another factor that may be responsible for the difference between previous findings and those presented here is the type of graphics used to display the simulated motion. The physical characteristics of the display or the graphics engines that generate the scene have varied greatly across the studies. Analyses and diagrams are presented showing results of the study and the differences generated from previous studies on this subject. R.E.P.

A90-26227#
PILOT/SURGEON INFLIGHT DECISION MAKING - A STUDY OF THE INTEGRATION OF AVIATION AND OPERATING ROOM COGNITIVE SKILLS
FREDERICK G. LIPPERT, III (Washington, University, Seattle), JOEL SHECHTER, and JIM BURKE IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 1. Columbus, OH, Ohio State University, 1989, p. 366-370.

A90-26228#
A CONTEXTUAL ANALYSIS OF PILOT DECISION MAKING
KATHLEEN L. MOSIER-O'NEILL (California, University, Berkeley; San Jose State University Foundation, CA) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 1. Columbus, OH, Ohio State University, 1989, p. 371-376. refs

The particular decision-making environment of the transport pilot is considered. It is suggested that, to fully understand decision-making in the cockpit, it is necessary to look at the main effects of contextual factors on each of three spheres or levels, as well as at the interaction on all three levels. The individual, the crew and the organization may be seen as concentric spheres of influence, each with its own accompanying 'layer of context'. Some of the potential effects on each level, and examples in which these forces may have had serious negative consequences for the decision-making process are reviewed and presented. Ways on how these influences may interact to hinder or facilitate judgment and decision-making processes are described. R.E.P.

A90-26229#
GENERAL AVIATION PILOT PERCEPTIONS OF DETERIORATING WEATHER CONDITIONS
CHARLES F. LAYTON and ELAINE MCCOY (Ohio State University, Columbus) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 1. Columbus, OH, Ohio State University, 1989, p. 377-383.
(Contract DTRS57-85-C-00101)

An effort is made to determine the underlying causes of some general aviation pilot fatalities stemming from pilot cognitive processes as a result of flying into adverse weather conditions. The research consists primarily of putting low-time pilots in a computer-simulated flight and analyzing their responses to specific questions about the weather information that most influenced their decisions. Results indicate that inexperienced pilots do not understand the complexities of weather, but as weather forecasts are reasonably accurate and the majority of low-time pilots are conservative in their approach to weather, any indication of less than ideal conditions is enough to keep them on the ground. However, if one combines the facts that less training is being required to obtain a pilots' license and that advice and weather information are becoming more difficult to obtain, and the idea that pilots become progressively less conservative about flying in questionable weather, concern should be expressed about the future state of affairs for general aviation pilots regarding adverse weather conditions and fatalities. R.E.P.

A90-26230#
PILOT JUDGMENT IN TCA-RELATED FLIGHT PLANNING
RICHARD J. TARREL (Battelle Aviation Safety Reporting System Program Office, Mountain View, CA) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 1. Columbus, OH, Ohio State University, 1989, p. 396-401.

The flight planning process is studied in terms of terminal control areas (TCAs). A pilot's awareness of traffic flow paths, their choice of flight path and altitude, the development of contingency plans, the use of terminal area charts are examined. Changes in flight training curricula that will enhance pilot awareness, improve flight planning practices, and decrease TCA-related problems are proposed. A sample task plan for TCA entry is presented. I.F.

A90-26232#
SANITY, COMMON SENSE AND AIR SAFETY - KEYS TO UNDERSTANDING PILOT ERROR
BERT L. BOTTA (Botta and Associates; Trans World Airlines, Inc., Saint Louis, MO) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 1. Columbus, OH, Ohio State University, 1989, p. 408-412. refs

The relationship between sanity, common sense, and air safety is examined. Natural proficiency and the importance of a pilot's habit and thought patterns toward flight safety are discussed. Nonfunctional thinking, stress symptoms, adverse reactions, and poor performance are considered. I.F.

A90-26233#
A COMPARISON OF COCKPIT COMMUNICATION B737 - B757
JOHN COSTLEY, DAVID JOHNSON, and DAVID LAWSON (Interaction Trainers, Ltd., Saint Ives, England) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 1. Columbus, OH, Ohio State University, 1989, p. 413-418.

Communications on the flight decks of the 737-200, the 737-300, and the 757, involving 16 different captains and 11 different copilots, are studied and compared. Data from the climb, cruise, and descent are analyzed in terms of frequency of communication, proportions of communication, push-pull ratios, and action rates. It is noted that there is a decrease in interpilot communication as the cockpit automation increases; there is a higher push-pull ratio with increasing automation of the flight deck; and pilot activity rates on aircraft with fully automated flight decks is equal to that in conventional cockpits. I.F.

A90-26234*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
COMMUNICATION VARIATIONS AND AIRCREW PERFORMANCE
BARBARA G. KANKI (NASA, Ames Research Center, Moffett Field, CA), VALERIE A. GREAUD (Syracuse University, NY), and CHERYL M. IRWIN (Texas, University, Austin) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 1. Columbus, OH, Ohio State University, 1989, p. 419-424. refs

Crew-related communication variations and their effects on performance are examined. The communication analysis involves evaluating the performance of 18 pilots to a high-fidelity full-mission simulation. Initiating speech consists of four categories: commands, questions, observations, and dysfluencies. Response speech is coded as: reply, acknowledgements, and zero response. A standard form of communication has been adopted which should aid in the coordination process and enhance crew performance. I.F.

A90-26237#
BEYOND CRM TO DECISIONAL HEURISTICS - AN AIRLINE GENERATED MODEL TO EXAMINE ACCIDENTS AND INCIDENTS CAUSED BY CREW ERRORS IN DECIDING

JOHN W. MAHER (Delta Air Lines, Inc., Boston, MA) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 1. Columbus, OH, Ohio State University, 1989, p. 439-444. refs

The use of the problem, acquire, survey, and select model to instruct pilots in decision making is examined. The procedures for using the model are described. The model is applied to various incidents and accidents to demonstrate its utility. I.F.

A90-26238#
KEY QUESTIONS FOR MAXIMUM CRM EFFECTIVENESS OR THE UNADDRESSED QUESTIONS IN CRM
HUGH HUNTINGTON (Huntington Group, Taos, NM) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 1. Columbus, OH, Ohio State University, 1989, p. 445-450.

The behavioral skills aspects of cockpit resource management (CRM) are examined. The differences between training for technical and behavioral skills are discussed. CRM is concerned with improving technical skills and proficiency along with redefining new behavior expectations. The four stages necessary for maximum transfer of new behaviors from the classroom to cockpit are described. Consideration is given to critical factors, psychological soundness, training environment, and organization integration. I.F.

A90-26239#
CRM VALIDATION PROGRAM
WILLIAM R. TAGGART (Resource Management Associates, Austin, TX) and ROY E. BUTLER (Pan American World Airways, Inc., Miami, FL) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 1. Columbus, OH, Ohio State University, 1989, p. 468-482. refs

Cockpit resource management (CRM) training evaluation and validation are discussed. Pan American's Flight Operations Resource Management (FORM) program is described, and FORM and LOFT are evaluated. It is noted that following CRM training there is a significant positive attitude shifts; a need for expanded training for check airmen and instructors; and LOFT provides the opportunity for crew members to test FORM skills and concepts in a true training environment. I.F.

A90-26240#
THE U.S. NAVAL AIRCREW COORDINATION TRAINING PROGRAM
ROBERT A. ALKOV (U.S. Navy, Naval Safety Center, Norfolk, VA) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 1. Columbus, OH, Ohio State University, 1989, p. 483-488. refs

The effectiveness of crew coordination and/or pilot judgment training efforts are evaluated in terms of changes in attitude. Twenty-six instructor pilots from the Navy and Marine helicopter fleets participated in a two week aircrew coordination instructor's training program. Attitudinal changes pre- and posttraining were evaluated using the cockpit management attitudes questionnarie of Helmreich (1984). The questionnaries revealed that posttraining the pilots are more aware of the effect of their own psychological and physical fitness on other crew members and the safety of the flight. I.F.

A90-26241*# Dayton Univ., OH.
COCKPIT RESOURCE MANAGEMENT SKILLS ENHANCE COMBAT MISSION PERFORMANCE IN A B-52 SIMULATOR
H. KINGSLEY POVENMIRE, MARTY R. ROCKWAY (Dayton, University, OH), JOSEPH L. BUNECKE, and MARK W. PATTON (U.S. Air Force Academy, Colorado Springs, CO) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 1. Columbus, OH, Ohio State University, 1989, p. 489-494. Research supported by NASA. refs
(Contract F33615-87-C-0012)

A cockpit resource management (CRM) program for mission-ready B-52 aircrew is developed. The relationship between CRM performance and combat mission performance is studied. The performances of six crew members flying a simulated high workload mission in a B-52 weapon system trainer are evaluated. The data reveal that CRM performance enhances tactical maneuvers and bombing accuracy. I.F.

A90-26244#
THE WORK, SLEEP, AND WELL-BEING OF BRITISH CHARTER PILOTS
MELANIE JAMES, ROGER GREEN, and ANDREW BELYAVIN (RAF, Institute of Aviation Medicine, Farnborough, England) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 2. Columbus, OH, Ohio State University, 1989, p. 512-517. refs

Results are presented from a study on the relationships between fatigue and the flight duty times of charter pilots in the UK. Sleep logs and biographical questionnaires from 136 pilots are analyzed in order to determine the factors that contribute to an acceptable duty period. It is found that the main factors influencing subjective fatigue and well-being at the end of a duty period are the time of day when the period ends, the length of the duty period, and the subjective state of the pilot before the duty period. The results suggest that total flying time contributes relatively little to the final subjective state of the pilot. R.B.

A90-26245#
WHAT DO PILOTS KNOW ABOUT THE .04 PERCENT BAC RULE?
SUSAN M. ROSS and LEONARD E. ROSS (Wisconsin, University, Madison) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 2. Columbus, OH, Ohio State University, 1989, p. 518-520.
(Contract PHS-AA-6093)

Results are presented from a study of pilots' knowledge concerning the FAA rule setting the legal blood alcohol concentration (BAC) at 0.04 percent. Questionnaires were sent to licensed pilots to determine their knowledge of the .04 percent BAC rule, their understanding of the relationship between the amount of alcohol consumed and BAC, and their confidence in making BAC judgments. It is found that 37.1 percent of the 1039 respondents were aware of the 0.04 BAC rule. Also, the results show the majority of pilots tended to overestimate the amount of alcohol that results in a BAC of 0.04 percent and tended to underestimate the time required for BAC to decay. R.B.

A90-26246#
A REAPPRAISAL OF AGING AND PILOT PERFORMANCE
PAMELA S. TSANG (Wright State University, Dayton, OH) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 2. Columbus, OH, Ohio State University, 1989, p. 521-526. refs

The effects of aging on cognitive performance of physically fit pilots are examined. Studies on the relationships between aging and cognitive functions are reviewed. Consideration is given to perceptual processes, memory, problem solving and decision making, psychomotor coordination, processing speed, and attention. An analysis of various studies suggests that studies concerning the general population may not be generalized to the pilot population. It is concluded that more research directly concerning the pilot popultion is needed. R.B.

A90-26247#
CABIN CREW AND SUPER LONG HAUL FLIGHT - PRELIMINARY FINDINGS
ROGER GREEN, MURIEL CHURCHILL (RAF, Institute of Aviation Medicine, Farnborough, England), and ROGER GREEN (British Airways, PLC, Health Services, London, England) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 2. Columbus, OH, Ohio State University, 1989, p. 527-532.

The effects of long transmeridional and meridional sectors on the performance and well-being of a cabin crew are examined. The study focuses on crews for flights between London and Hong Kong or Johannesburg. The analysis includes sleep logs,

questionnaires, assessments of subjective factors, and preflight and postflight response times for verbal reasoning tasks. The relationship between the time when a rest break is taken and the onset of fatigue is discussed. Also, the performances and well-being of crews on nonstop and direct flights are compared. R.B.

A90-26249#
MEASURING STRESS OF HELICOPTER PILOTS - AN ANALYSIS OF DEFICIENCIES IN CRITICAL FLIGHT SITUATIONS
MICHAEL KASTNER, CLAUDIA HARSS, and LILLY BEERMAN (Muenchen, Universitaet der Bundeswehr, Munich, Federal Republic of Germany) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 2. Columbus, OH, Ohio State University, 1989, p. 539-544.

A study on the stress and strain experienced by helicopter pilots engaging in low altitude night flight with night vision goggles is discussed. The theoretical background of the study is reviewed, focusing on the method of Stress-Coping Analysis (Kastner, 1986). The characteristics of the person, situation, and interactions in the study are evaluated. The psychological, physiological, and observational data used in the study are briefly described. Selected preliminary results of the study are given, including an example on the relationship between the risk-taking attitudes of pilots and their judgement and experience of stress during various flight situations. R.B.

A90-26250#
THE EFFECTS OF EXTENDED-OPERATIONS OF INFERENTIAL MULTI-CUE JUDGMENT
ROBERT P. MAHAN (Georgia, University, Athens) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 2. Columbus, OH, Ohio State University, 1989, p. 545-550. refs

The effects of an extended computerized work regime on the performance of a multicue judgment are studied. The performance of four subjects performing judgment tasks for a 13.5-hr extended work period (with 1.5 total hours of rest) were analyzed using the lens model (Brunswik, 1955). The results show that judgment task performance became poorer over the duration of the experiment, while the rate of problem solving did not significantly change. R.B.

A90-26251#
FATIGUE AND SAFETY - A REASSESSMENT
NICK MCDONALD, RAY FULLER (University of Dublin Trinity College, Republic of Ireland), and GEORGE WHITE (Ryanair, Dublin, Republic of Ireland) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 2. Columbus, OH, Ohio State University, 1989, p. 551-556. refs

Epidemiological studies of fatigue and road transport accidents are examined, emphasizing their applicatibility to aviation. The factors influencing fatigue and the processes of coping with and adjusting to fatigue are examined. It is suggested that there is a need to apply the epidemiological approach to studies on aviation safety. Also, the need for research on the processes of coping with and managing fatigue is noted. R.B.

A90-26252#
LINEAR STRUCTURAL MODELING OF PILOT RISK PERCEPTION - SOLUTIONS TO PROBLEMS OF NON-NORMAL RESPONSE DISTRIBUTIONS
R. L. BROWN (Wisconsin, University, Madison), HAROLD HOLMES, JERRY WITHERILL (Wisconsin, University, Whitewater), and JOHN M. DORSEY (Wisconsin Bureau of Aeronautics, Madison) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 2. Columbus, OH, Ohio State University, 1989, p. 557-563. refs

The robustness of the Normal Theory Generalized Least Squares (NTGLS) method (Brown, 1989) in structural equation modeling of nonnormally distributed data is evaluated with a simulation study. The results show that asymmetry in response distributions has a deleterious effect on the percent of structural models retained. Also, a simulation study was conducted to compare Browne's (1974) asymptotic distribution free (ADF) estimator and Muthen's (1985) latent projection (TOBIT) estimator. It is found that both the NTGLS and ADF estimation procedures produced poor results, while the TOBIT procedure produced superior estimates at all asymmetry levels. The implications of the study for modeling pilot risk perceptions is noted. R.B.

A90-26253#
FITTS AND JONES' ANALYSIS OF PILOT ERROR - 40 YEARS LATER
JOHN M. FLACH, JOHN F. LARISH, and LISA F. WEINSTEIN (Illinois, University, Urbana) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 2. Columbus, OH, Ohio State University, 1989, p. 564-569. refs

The system for the classifiaction of pilot error developed from the error data collected from military pilots by Fitts and Jones (1947) is examined. The questions used by Fitts and Jones were adapted for comparing errors in aviation, operating an automobile, and operating computers. The error data from each of these sets were classified using the Fitts and Jones taxonomy. It is found that errors in reading and interpreting instruments does not generalize as well as the taxonomy for control errors. The control errors for automobiles and computers are very similar. It is concluded that, while the specific nature of errors may change, there may be a general basis for categorizing human error that generalizes across many levels of automation. R.B.

A90-26256#
TESTING FOR POTENTIAL PROBLEM PILOTS AND HUMAN ERROR IN THE COCKPIT
R. SELLARDS IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 2. Columbus, OH, Ohio State University, 1989, p. 582-587. refs

Studies of accident susceptibility are reviewed, focusing on the determination of potential problem pilots. Consideration is given to the use of Cockpit Resource Management Training to address issues related to personality and accident susceptibility. The link between physical and psychophysical factors in accident susceptibility is examined. Also, the effects of social, emotional, and psychophysiological stresses on accident susceptibility are discussed. R.B.

A90-26259#
THE USE OF SIMULATORS IN AB-INITIO HELICOPTER-TRAINING
FRANK FEHLER (Bundeswehr, Bueckeburg, Federal Republic of Germany) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 2. Columbus, OH, Ohio State University, 1989, p. 600-604.

The helicopter training program for German military pilots is described. The system of assessing student progress is outlined. Results are presented from a study on the use of a simulator to teach pilot candidates the fundamentals of helicopter control. The schedule of the basic training program is presented. It is found that simulator training is very useful in teaching basic helicopter flight. R.B.

A90-26261#
...IN THE BEGINNING - AB INITIO TRAINING FOR TILTROTOR CREWS
ROBERT RYAN WILKINS (Boeing Helicopters, Philadelphia, PA) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 2. Columbus, OH, Ohio State University, 1989, p. 611-620. refs

Issues concerning the development of a tiltrotor training program are examined. The differences between flying tiltrotor, helicopter, and fixed-wing aircraft are outlined to demonstrate the importance of specific training for tiltrotor flight. Results are presented from

an assessment of pilot tasks for the V-22 tiltrotor program, demonstrating the need for ab initio training. A method for establishing this ab initio training and suggestions for developing a training system are discussed. R.B.

A90-26262#
PILOT COMPETENCY - AN ANALYSIS OF ABILITIES REQUISITE TO PROFESSIONAL FLIGHT CREW DEVELOPMENT
GRAHAM J. F. HUNT (Massey University, Palmerston North, New Zealand) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 2. Columbus, OH, Ohio State University, 1989, p. 621-626. refs

Methods for evaluating pilot competency are examined. Consideration is given to the problem of defining the nature of pilot competency and using the definition to produce effective licensing and examining program. An analysis of pilot competency based on the NEBEAT (Hunt, 1986) knowledge-process hierarchy is described. Preliminary results from this competency analysis are given. R.B.

A90-26263#
EXPLORATORY RESEARCH AND DEVELOPMENT - THE U.S. ARMY AVIATOR CANDIDATE CLASSIFICATION ALGORITHM
RONALD JOHN LOFARO and GABRIEL P. INTANO (U.S. Army, Research Institute, Fort Rucker, AL) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 2. Columbus, OH, Ohio State University, 1989, p. 627-633. refs

A testing procedure was developed for assigning U.S. Army aviator candidates to operational heliopters before the tenth week of initial flight training. The methods used to search for profiles of high-time aviators for each specific helicopter are described. Two approaches were used: analyses of current test batteries covering psychomotor, cognitive, and personality traits, and small group analyses of high-time aviators for each of the Army's helicopters. The results were used to develop a final algorithm to show the specific performance skills and traits indicative of the underlying abilities and traits of high-time aviators of each type of helicopter. R.B.

A90-26264#
USING THE CANADIAN AUTOMATED PILOT SELECTION SYSTEM TO PREDICT PERFORMANCE IN PRIMARY FLYING TRAINING - STRAIGHT AND LEVEL FLIGHT
BARRY SPINNER (Canadian Forces, Personnel Applied Research Unit, Willowdale, Canada) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 2. Columbus, OH, Ohio State University, 1989, p. 634-639.

Results are presented from the application of Spinner's (1988) model for the transformation, reduction, and analysis of the Canadian Automated Pilot Selection System (CAPSS) predictor data. The CAPSS is a moving-base single-engine aircraft simulator to test psychomotor coordination for the evaluation of pilot candidates. The data analyzed in this study is from straight and level flight. It is found that the best equations in the method represent a 14 percent improvement over the aircrew selection battery in current use. R.B.

A90-26265#
AIRCREW TEAM DYNAMICS - A COMPREHENSIVE CREW MANAGEMENT PROGRAM FOR AMERICA WEST AIRLINES PILOTS AND FLIGHT ATTENDANTS
MICHAEL J. VANDERMARK (America West Airlines, Phoenix, AZ) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 2. Columbus, OH, Ohio State University, 1989, p. 640-645.

A90-26266#
EXPLORING SITUATIONAL AWARENESS - A REVIEW AND THE EFFECTS OF STRESS ON RECTILINEAR NORMALIZATION
DENNIS B. BERINGER (New Mexico State University, Las Cruces) and PETER A. HANCOCK (Southern California, University, Los Angeles, CA) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 2. Columbus, OH, Ohio State University, 1989, p. 646-651. refs

An study of the component skills which contribute to the creation and maintenance of situational awareness is presented. Definitions of situational awareness and methods for measuring situational awareness are reviewed. The maintenance of situational awareness as measured by a courseline recall task was studied, focusing on the relationship between stress induced by concurrent task performance with and without memory load. Preliminary results are presented to demonstrate the method for studying the maintenance of situational awareness. R.B.

A90-26267#
COMPARISON OF TRAINING PERFORMANCE CRITERIA FOR USAF PILOT SELECTION AND CLASSIFICATION
THOMAS R. CARRETTA (USAF, Human Resources Laboratory, Brooks AFB, TX) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 2. Columbus, OH, Ohio State University, 1989, p. 652-657.

Procedures to determine training performance criteria to reflect the quality of USAF Undergraduate Pilot Training students are discussed. The tests used to evaluate pilot trainees are described. The performance criteria are based on daily flying scores, check flight scores, academic grades, and flying hours. It is found that class standings generated from a training evaluation algorithm are closely related to follow-on training recommendations. However, when the algorithm is modified to include students who were eliminated from the program the results were less successful. R.B.

A90-26268#
SELECTING STUDENT NAVAL PILOTS FOR TRAINING PIPELINES AND POST-GRADUATE FLYING DUTY ASSIGNMENTS
EDWARD E. EDDOWES (U.S. Navy, Naval Air Training Command, Corpus Christi, TX) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 2. Columbus, OH, Ohio State University, 1989, p. 658-662.

Consideration is given to the development of measures to make U.S. Navy pilot training more effective. The performance of student pilots in different stages of training are analyzed to determine problem areas. The problems in various U.S. Navy pilot training programs are compared. The development of an automated training integration system to collect and analyze training performance data is discussed. R.B.

A90-26269#
THE DLR TEST SYSTEM FOR AB-INITIO PILOT SELECTION
KLAUS-MARTIN GOETERS, HANS-JUERGEN HOERMANN, and PETER MASCHKE (DLR, Hamburg, Federal Republic of Germany) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 2. Columbus, OH, Ohio State University, 1989, p. 663-668.

The methods used by the DLR for the psychological selection of operators for complex systems are discussed. A program for ab initio pilot selection and training is reviewed. The traits considered in the psychological evaluation of candidates for pilot selection are listed. Also, results are presented from empirical validiation studies on the ability of the psychomotor tests for predicting occupational success. The test considered include complex coordination, two-hand coordination, multiple task performance, instrument coordination, and link simulator tests. R.B.

A90-26270#
THE USE OF SURROGATE MEASUREMENT FOR THE PREDICTION OF FLIGHT TRAINING PERFORMANCES
JANET J. TURNAGE, ROBERT S. KENNEDY, RICHARD D.

GILSON, JAMES P. BLISS, and MARGARET D. NOLAN (Central Florida, University, Orlando, FL) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 2. Columbus, OH, Ohio State University, 1989, p. 669-675. refs

Results are presented from a study on the use of surrogate measurements to predict complex performance on a low-cost flight trainer. Subjects were tested on the Automated Performance Test System (APTS) of Kennedy et al. (1985) and performed landings on a flight simulator. It is found that a subset of the APTS battery, consisting of the manikin, pattern comparison, and reaction time tests was sufficient to account for most of the explainable variance in flight performance. R.B.

A90-26271*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
LEADER PERSONALITY AND CREW EFFECTIVENESS - A FULL-MISSION SIMULATION EXPERIMENT
THOMAS R. CHIDESTER and H. CLAYTON FOUSHEE (NASA, Ames Research Center, Moffett Field, CA) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 2. Columbus, OH, Ohio State University, 1989, p. 676-681. refs

A full-mission simulation research study was completed to assess the impact of individual personality on crew performance. Using a selection algorithm described by Chidester (1987), captains were classified as fitting one of three profiles along a battery of personality assessment scales. The performances of 23 crews led by captains fitting each profile were contrasted over a one and one-half day simulated trip. Crews led by captains fitting a typical particulate debris produced by the animal; (2) microtivation and interpersonal skill) were consistently effective and made fewer errors. Crews led by captains fitting a Negative Expressive profile (below average achievement motivation, negative expressive style, such as complaining) were consistently less effective and made more errors. Crews led by captains fitting a Negative Instrumental profile (high levels of competitiveness, Verbal Aggressiveness, and Impatience and Irritability) were less effective on the first day but equal to the best on the second day. These results underscore the importance of stable personality variables as predictors of team coordination and performance. Author

A90-26272*# Texas Univ., Austin.
MANAGERIAL LEADERSHIP ASSESSMENT - PERSONALITY CORRELATES OF AND SEX DIFFERENCES IN RATINGS BY LEADERS, PEERS, AND FOLLOWERS
ROBERT H. GIBSON and JOHN WILHELM (Texas, University, Austin) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 2. Columbus, OH, Ohio State University, 1989, p. 682-685. Research supported by NASA. refs

A performance appraisal was conducted at a Fortune 500 airline. Evaluations of each manager were taken from his or her management, peers and subordinates. These ratings were related to personality clusters revealing patterns for males similar to those found between personality and performance in pilot populations. A case is made that piloting aircraft requires similar skills to managing other complex enterprises and that similar profiles predict success in each. Author

A90-26273*# Texas Univ., Austin.
PERSONALITY BASED CLUSTERS AS PREDICTORS OF AVIATOR ATTITUDES AND PERFORMANCE
STEVE GREGORICH, ROBERT L. HELMREICH, JOHN A. WILHELM (Texas, University, Austin), and THOMAS CHIDESTER (NASA, Ames Research Center, Moffett Field, CA) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 2. Columbus, OH, Ohio State University, 1989, p. 686-691. refs
(Contract NCC2-286)

The feasibility of identification of personality-based population clusters was investigated along with the relationships of these subpopulations to relevant attitude and performance measures. The results of instrumental and expressive personality tests, using the Personal Characteristics Inventory (PCI) test battery and the Cockpit Management Attitudes Questionnaire, suggest that theoretically meaningful subpopulations exist among aviators, and that these groupings are useful in understanding of personality factors acting as moderator variables in the determination of aviator attitudes and performance. Out of the three clusters most easily described in terms of their relative elevations on the PCI subscales ('the right stuff', the 'wrong stuff', and the 'no stuff'), the members of the right stuff cluster tended to have more desirable patterns of responses along relevant attitudinal dimensions. I.S.

A90-26274*# Texas Univ., Austin.
WHEN TRAINING BOOMERANGS - NEGATIVE OUTCOMES ASSOCIATED WITH COCKPIT RESOURCE MANAGEMENT PROGRAMS
ROBERT L. HELMREICH and JOHN A. WILHELM (Texas, University, Austin) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 2. Columbus, OH, Ohio State University, 1989, p. 692-697. refs
(Contract NCC2-286)

Participants' self-reports and measures of attitudes regarding flightdeck management indicate that Cockpit Resource Management training is positively received and causes highly significant changes in attitudes regarding crew coordination and personal capabilities. However, a subset of participants react negatively to the training and show boomerangs (negative change) in attitudes. Explorations into the causes of this effect pinpoint personality factors and group dynamics as critical determinants of reactions to training and the magnitude and direction of attitude change. Author

A90-26275#
FLIGHT SAFETY - A PERSONALITY-PROFILE-BASED DESIGNATION OF AB INITIO HELICOPTER FLIGHT TRAINING INSTRUCTORS AND INSTRUCTOR-TRAINEE COUPLING
JULIO CESAR MODESTO VALERIO (Base Aerea Naval, Sao Pedro da Aldeia, Brazil), ERICE DA SILVA MIRANDA, VERA LUCIA DE GAIA CAMPOS, and MARTA NOLDING (Servico de Selecao do Pessoal da Marinha, Rio de Janeiro, Brazil) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 2. Columbus, OH, Ohio State University, 1989, p. 698-702. refs

A90-26277#
DETECTION OF OPTICAL FLOW PATTERNS DURING LOW-ALTITUDE FLIGHT
FRED H. PREVIC (USAF, School of Aerospace Medicine, Brooks AFB, TX) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 2. Columbus, OH, Ohio State University, 1989, p. 708-713. Research supported by USAF. refs

The ability to use optical flow cues to detect foreground ridges during low-altitude flight was investigated. Ten video segments from actual low-altitude missions over three different terrains were digitized, and the pure motion information contained within them was isolated. The isolated motion cueing was insufficient in revealing the outline of the foreground ridge, regardless of terrain type. Subsequent simulations involving moving-dot images revealed that optical flow discontinuity detection is especially difficult for a sparse, irregular, color-contrast texture, which most resembles the terrain found in western deserts. Author

A90-26279#
THE EFFECTS OF COGNITIVE WORKLOAD ON PERIPHERAL VISION
EDWARD J. RINALDUCCI, DONALD L. LASSITER, PAUL N. ROSE, MARY MACARTHUR, and LAWRENCE MITCHELL (Central Florida, University, Orlando, FL) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 2. Columbus, OH, Ohio State University, 1989, p.

720-725. refs
(Contract DAAL03-87-K-0014)

The goal of this research was to investigate the effects of cognitive or foveal load on sensitivity in the peripheral visual field. In the first three experiments, foveal load was manipulated by comparing the fixation of a cross vs a first-order compensatory tracking task which became more difficult with each succeeding experiment. Peripheral sensitivity was determined simultaneously for light flashes presented at different eccentricities along the horizontal meridian. The effects of training on the task were also evaluated in terms of changes in peripheral sensitivity. In the fourth experiment, the perimetry task was made more difficult by including an additional meridian. The results suggest that the perimetry task is similar to a vigilance task and acts to reduce the overall level of arousal over a period of time. The introduction of the tracking task results in either the maintenance of arousal and therefore sensitivity, an increase in arousal and sensitivity, or a decrement in sensitivity, depending upon the difficulty of the tracking task.
Author

A90-26280#
SENSITIVITY OF DETECTING SIMULATED ASCENT AND DESCENT IN PERIPHERAL VISION
DAVID A. WHEELER and CONRAD L. KRAFT (Washington, University, Seattle) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 2. Columbus, OH, Ohio State University, 1989, p. 726-731. Research supported by the University of Washington. refs

Subjects performed a tracking task in the central visual field at the same time that dots were moving toward them in the peripheral vision. Thresholds for detecting changes in slope of dot movement in peripheral vision were measured. The results indicated that changes in slope of motion are detectable using only the peripheral vision and that threshold is dependent upon display parameters. Lowest thresholds were found with two dots/display moving with optic flows greater than 1.4 eyeheights/sec. These results suggest that, with appropriate display parameters, the peripheral vision is a possible location for display of altitude change information.
Author

A90-26281#
THE VECTION ILLUSION IN THE AERO-MARINE ENVIRONMENT - A FLIGHT SAFETY CONCERN
TIMOTHY J. UNGS (USCG, Kodiak, AK; Wright State University, Dayton, OH) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 2. Columbus, OH, Ohio State University, 1989, p. 732-736. refs

This study sought to gauge the occurrence of the vection illusion under different light and sea states among rotary winged pilots in the aero-marine environment. Data were obtained by questionnaire survey of 19 operational U.S. Coast Guard Air Stations. A total of 267(79.9 percent) pilots participated. 248(92.5 percent) pilots responded they had experienced the illusion while operating over open water. 209(84.6 percent) reported that dark visual conditions while 8(3.2 percent) reported that bright visual conditions increased the likelihood of experiencing vection. Smooth water conditions were thought by 81(37.8 percent) while 114(46.2 percent) thought rough conditions enhanced the vection experience. In conclusion, the vection illusion is a common experience in the aero-marine environment particularly during low/no light visual conditions. Pilots may generate unnecessary aircraft movement raising flight safety concerns.
Author

A90-26282#
GROUND-TEXTURE INFORMATION FOR AIMPOINT ESTIMATION
LISA F. WEINSTEIN (Illinois, University, Savoy) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 2. Columbus, OH, Ohio State University, 1989, p. 737-742. refs

This experiment examined the effects of ground texture on aimpoint estimation in a landing-judgment task. Subjects viewed a simulated landing approach which stopped 'in midair'. Subjects were asked to estimate the point at which they would land if they continued on the current path. Results indicate that structured texture, and expanding texture elements improved performance. Furthermore, with dot patterns, performance was better when the aimpoint was represented by a specific point on the display.
Author

A90-26284#
THE EFFECT OF CHANGES IN EDGE AND FLOW RATES ON ALTITUDE CONTROL
LAWRENCE WOLPERT, KIMBERLEY A. REARDON (Systems Research Laboratories, Inc., Dayton, OH), and RIK WARREN (USAF, Armstrong Aerospace Medical Research Laboratories, Wright-Patterson AFB, OH) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 2. Columbus, OH, Ohio State University, 1989, p. 749-754. refs

Visual scenes during flight are known to decrease in 'optical activity' with increasing altitude. The effects of changes in the global optical flow rate (defined as the flight speed divided by altitude) and the edge rate (defined as the number of edges traversed per unit time) on the altitude control of the aviator are investigated using a computer to generate self-motion events for 20 naive subjects with no previous simulator or piloting experience. In all test events, which represented flight at an initial altitude of 64 ft over a flat rectangular field, subjects were asked to actively maintain an assigned altitude. It was found that changes in both flow rate and edge rate were effective in causing subjects to adjust their altitudes in accordance with the flow and edge 'forcing functions', with the effect of the former being more powerful.
I.S.

A90-26285#
INTERCORRELATIONS AMONG PHYSIOLOGICAL AND SUBJECTIVE MEASURES OF WORKLOAD
VALERIE GAWRON, JOHN BALL (Calspan Corp., Buffalo, NY), TIMOTHY SLATER, SAMUEL SCHIFLETT (USAF, School of Aerospace Medicine, Brooks AFB, TX), and JAMES MILLER (USAF, Flight Test Center, Edwards AFB, CA) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 2. Columbus, OH, Ohio State University, 1989, p. 755-760. Research supported by the U.S. Army. refs

Data are presented on correlations between physiological and subjective measures of aircraft personnel workload, developed and evaluated by NASA and FAA, using U.S. qualified C-130 pilots who have passed an Air Force flight medical examination within the previous 12 months. These measures considered were heart rate, heart-rate variability, vagal tone, Subjective Workload Assessment Technique, Crew Status Survey Ratings, and Profile of Mood States. It was found that, although all these measures are purported measures of pilot workload, they are neither highly correlated nor highly reliable.
I.S.

A90-26286*# Illinois Univ., Urbana.
TASKILLAN - A SIMULATION TO PREDICT THE VALIDITY OF MULTIPLE RESOURCE MODELS OF AVIATION WORKLOAD
INGE A. LARISH, CHRISTOPHER D. WICKENS, LEON SEGAL, BILL SHERMAN, and AARON M. CONTORER (Illinois, University, Urbana) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 2. Columbus, OH, Ohio State University, 1989, p. 761-766. refs
(Contract NAG2-308)

The extent to which flight simulation models of increasing complexity are successful in predicting pilot performance was investigated using four models of increasing sophistication addressed by the TASKILLAN (for task skill analysis) computer-generated helicopter simulation. At the simplest level of complexity was the total task model (Model T), followed by the demand model (Model D), the undifferentiated capacity model (Model U), and, ultimately, by the multiple resources model (Model M), which is at the highest level of sophistication addressed by the TASKILLAN project. It was found that the correlations between variables were higher with the two more sophisticated models (U

and M), which impose a penalty for increased difficulty in time-sharing. The performance prediction was best with the Model U, while the best predictors of subjective measures were models D and M. I.S.

A90-26287#
A320 CREW WORKLOAD MODELLING
J. J. SPEYER (Airbus Industrie, Blagnac, France), R. D. BLOMBERG (Dunlap and Associates, Inc., Norwalk, CT), and J. P. FOUILLOT (Paris V, Universite, France) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 2. Columbus, OH, Ohio State University, 1989, p. 767-779. refs

This paper describes the development process of the Airbus Workload Model and its evolution from the A310-200 certification to that of A320. Special attention is given to the data collection procedures, the development of scenarios, the program results, the statistical tests, and the time-line plots. It is shown that one of the great strengths of the model is its ability to offer continuous data through the entire duration of a real flight. The model can be used to predict the pilot workload ratings in a valid and reliable manner and during the development of new aircraft to assess the potential implications of design decisions on workload. I.S.

A90-26288#
STALL VALIDATION
GERALD P. CHUBB (SofTech, Inc., Fairborn, OH) and RICHARD A. MILLER (Ohio State University, Columbus) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 2. Columbus, OH, Ohio State University, 1989, p. 784-789. refs

This paper describes the results of model validation for the STALL (for saturation of tactical aviator load limits) model, which is a queuing network theory approach to the pilot work-load analysis. Three treatment conditions were examined: (1) portraying the impact of independent nonidentical arrival streams; (2) simulating the fly-out phase, where a homogeneous activity pool is split into Type A and Type B activity pools; and (3) combining the use of case 1 and case 2. The results of simulation runs are presented in the form of graphs. I.S.

A90-26289#
THE PROCESSING DEMANDS OF TRACKING STRATEGIES
BARRY P. GOETTL (Clemson University, SC) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 2. Columbus, OH, Ohio State University, 1989, p. 790-795. Research supported by USAF. refs

The processing demands of tracking strategies for operating systems of high-order control dynamics, such as a high-performance aircraft, were evaluated using Navon's (1984, 1985) optimum-maximum procedure. Subjects were asked to perform two tracking tasks concurrently, with the goal of keeping two cursors, one moving horizontally and one vertically (controlled by the right and the left hand, respectively) as close as possible to a red cross in the center of a display. Tracking strategy was manipulated between groups. One group of subjects performed tracking tasks with the impulse strategy, while the other group used the continuous strategy. The analysis of tracking strategies suggested that the continuous strategy demanded more central-processing resources than the double-impulse strategy. I.S.

A90-26290*# San Jose State Univ., CA.
DISSOCIATION REVISITED - WORKLOAD AND PERFORMANCE IN A SIMULATED FLIGHT TASK
TERESA KING (San Jose State University, CA), JOY HAMERMAN-MATSUMOTO (Bio-Dynamics Research and Development Corp., Eugene, OR), and SANDRA G. HART (NASA, Ames Research Center, Moffett Field, CA) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 2. Columbus, OH, Ohio State University, 1989, p. 796-801.

The multiple resource model has been used as the theoretical basis for interpreting single-to-dual task changes in measures of performance and workload ratings. Inconsistent relationships among these measures have been termed dissociation. It is possible they are an artifact of the way performance and workload measures are collected; performance measures are available for the components of a complex task whereas workload ratings are integrated across all of the tasks performed within an interval of time. This study compared component ratings with global ratings and found that component ratings provide better information about subjects' task strategies and in interpreting the resultant relationships between workload ratings and performance. Author

A90-26291#
OBJECTIVE MEASURES OF WORKLOAD - SHOULD A SECONDARY TASK BE SECONDARY?
MICHAEL A. VIDULICH (USAF, Armstrong Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 2. Columbus, OH, Ohio State University, 1989, p. 802-807. refs

This paper examines the viability of two central assumptions in the traditional secondary-task technique for measuring work load: that the secondary task be given a low priority relative to the primary task, and that the sensitivity of the secondary task performance is inversely related to its intrusiveness to the primary task. The sources of these two beliefs and the bases for challenges to them are examined, and a possible alternative to the secondary-task technique is investigated. These experiments focused on the effect of priority instructions in determining the sensitivity of the added (i.e., secondary) task's performance to the measured (i.e., the primary) task's work load, with special consideration given to the relationship between sensitivity and intrusiveness. The results suggest that the sensitivity of the added task might be directly linked to intrusiveness. I.S.

A90-26292#
IN-FLIGHT AND POST-FLIGHT ASSESSMENT OF PILOT WORKLOAD IN COMMERCIAL TRANSPORT AIRCRAFT USING SWAT
WILLIAM H. CORWIN (Douglas Aircraft Co., Long Beach, CA) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 2. Columbus, OH, Ohio State University, 1989, p. 808-813.

This paper examines the effect of probe timing (in-flight vs post-flight) on the subjective assessment of work load in flights containing both low-level and high-level work loads by commercial airline pilots who flew a six-degree-of-freedom FAA-certified Phase KK B-727 simulator. Each pilot flew three different flights: (1) a 30-min-long standard or 'nominal flight'; (2) a 30-min-long 'communication' flight, in which normal duties were coupled with requirements to tune and talk on the command ratio; and (3) an 1.5-hr-long 'malfunction flight' containing two diversions and engine and hydraulic system failures (1hr 30 min). Results indicated no effect of probe timing for the nominal and communication flights but a significant interaction of probe timing and phase-of-flight in the malfunction flight, in which post-flight ratings of high work-load events were higher than in-flight ratings of the same event. I.S.

A90-26294*# University of Southern California, Los Angeles.
THE EFFECTS OF CONTROL ORDER, FEEDBACK, PRACTICE, AND INPUT DEVICE ON TRACKING PERFORMANCE AND PERCEIVED WORKLOAD
P. A. HANCOCK and M. A. ROBINSON (Southern California, University, Los Angeles, CA) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 2. Columbus, OH, Ohio State University, 1989, p. 820-825. refs
(Contract NCC2-379)

The present experiment examined the influence of several task-related factors on tracking performance and concomitant workload. The manipulated factors included tracking order, the presence or absence of knowledge of performance, and the control device. Summed root mean square error (rmse) and perceived

workload were measured at the termination of each trial. Perceived workload was measured using the NASA Task Load Index (TLX) and the Subjective Workload Assessment Technique (SWAT). Results indicated a large and expected effect for track order on both performance and the perception of load. In general, trackball input was more accurate and judged for lower load than input using a mouse. The presence or absence of knowledge of performance had little effect on either performance or workload. There were a number of interactions between factors shown in performance that were mirrored by perceived workload scores. Results from each workload scale were equivalent in terms of sensitivity to task manipulations. The pattern of results affirm the utility of these workload measures in assessing the imposed load of multiple task-related variables. Author

A90-26295#
WORKLOAD ASSESSMENT BY SECONDARY TASKS AND THE MULTIDIMENSIONALITY OF HUMAN INFORMATION PROCESSING RESOURCES
DIETRICH MANZEY (DLR, Institut fuer Flugmedizin, Hamburg, Federal Republic of Germany) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 2. Columbus, OH, Ohio State University, 1989, p. 826-831. refs

This paper describes a procedure of work-load assessment by secondary-task technique. Four tasks were assigned to subjects, assuming that two of these tasks, namely, the mental arithmetic (MA) and the Sternberg task, tap mainly the perceptual-cognitive resources. The other two tasks, the discrete cursor positioning (CP) and the switchboard task (SW), were classified as tasks that demand mainly the response-related resources. The performance measure of each task was the number of correct responses during each 2.5-min trial. It was found that the time-sharing efficiency was highest in the conditions in which the MA task had to be combinded with discrete CP or the SW task. I.S.

A90-26298#
A HUMAN PERFORMANCE RE-INTERPRETATION OF FACTORS CONTRIBUTING TO AN AIRLINE AVIATION ACCIDENT
NEIL JOHNSTON IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 2. Columbus, OH, Ohio State University, 1989, p. 848-853. refs

The feasibility of applying social sciences to assess the contribution of the human factor to an airline aviation accident is discussed. As a demonstration of the appplicability of social scientific theory to the accident analysis, examples are presented in which a breakdown in cockpit management and team work occurred during situations involving malfunctions of aircraft systems in flight. It is suggested that operationally trained human-factor specialists should be included in accident investigation teams. I.S.

A90-26299#
THE PSYCHOLOGICAL PROFILE IN AIRCRAFT ACCIDENT INVESTIGATION
WALTER E. SIPES (USAF, School of Aerospace Medicine, Brooks AFB, TX) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 2. Columbus, OH, Ohio State University, 1989, p. 854-859. refs

This paper presents a guide, or checklist, that could be used for making a psychological profile of an aircrew after an aircraft accident, based on information obtained from records and interviews. The checklist, to be used as a standardized approach to look at human factors of an aircraft accident, consists of seven standardized areas: the developmental history, psychosocial indices, the psychological flying analysis, the pharmacological history, physiological factors, physical-condition factors, and pathological factors. I.S.

A90-26300#
EXPLORATORY EXPERIENCE IN MENTAL PROCESS IN SOME AIRPLANE ACCIDENTS DUE TO HUMAN FACTORS
VINCENT CARMIGNIANI (Airbus Industrie, Paris, France) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 2. Columbus, OH, Ohio State University, 1989, p. 860-865.

A90-26302#
RATES AND RISK FACTORS FOR ACCIDENTS AND INCIDENTS VERSUS VIOLATIONS FOR U.S. AIRMEN
M. E. LUBNER, M. PHIL, D. A. ISHERWOOD, J. S. MARKOWITZ, and L. F. LESTER (Columbia University, New York) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 2. Columbus, OH, Ohio State University, 1989, p. 872-877. Research sponsored by FAA. refs

This paper compares risk factors involved in aircraft accidents (A), incidents (I), and violations (V) of the Federal Aviation Regulations, using government reports from NTSB, FAA, NASA, military bases, and published papers as sources of epidemiological data. Epidemiologic case-control methodology is used to assess the probability of having an occurrence. True rates are calculated including both morbidity and mortality. The variables assessed for odds ratios include gender, age, the FAA region, and the class of medical and airmen certificates. Results showed that having a Class III medical certificate is protective against all occurrences, while having a Class I was a risk factor for all three occurrences, especially V. Private pilots had an elevated risk for all three occurrences. I.S.

A90-26304#
HUMAN FACTORS IN ATC OPERATIONS - ANTICIPATORY CLEARANCES
LOREN J. ROSENTHAL and VINCENT J. MELLONE (Battelle Aviation Safety Reporting System Program Office, Mountain View, CA) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 2. Columbus, OH, Ohio State University, 1989, p. 884-889.

This paper addresses control problems arising from the use of anticipatory runway clearances. Instances are described where unexpected events derogated the safety of anticipatory clearances given by controllers. Chief among them were pilot actions/inactions such as failures to hold short, unexpected performances on approach, and delayed or unexpected taxi actions. Practical steps to enhance safety of anticipatory clearances are suggested. I.S.

A90-26305#
ANALYSIS OF AIR TRAFFIC CONTROL OPERATING IRREGULARITIES
PAUL STAGER and DONALD HAMELUCK (York University, Toronto, Canada) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 2. Columbus, OH, Ohio State University, 1989, p. 890-895. Research supported by Transport Canada. refs

Reports prepared during the investigation of 301 operating irregularities were analyzed in order to identify the factors most likely to precipitate air traffic control incidents. The analysis indicated that the occurrence of incidents was not related directly to rated workload. Operating irregularities tended to occur under conditions of moderate or low workload and normal complexity. The most frequently cited primary categories of error in the incident reports were attention, judgement, and communication. However, a revision of the present category system is required and should reflect contemporary approaches to human error. Author

A90-26306*# Hampton Univ., VA.
MULTI-MEDIA AUTHORING - INSTRUCTION AND TRAINING OF AIR TRAFFIC CONTROLLERS BASED ON ASRS INCIDENT REPORTS
HERBERT B. ARMSTRONG (Hampton University, VA) and RENATE J. ROSKE-HOFSTRAND (NASA, Ames Research Center, Moffett Field, CA) IN: International Symposium on Aviation

Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 2. Columbus, OH, Ohio State University, 1989, p. 896-901. refs

This paper discusses the use of computer-assisted instructions and flight simulations to enhance procedural and perceptual motor task training. Attention is called to the fact that incorporating the accident and incident data contained in reports filed with the Aviation Safety Reporting System (ASRS) would be a valuable training tool which the learner could apply for other situations. The need to segment the events is emphasized; this would make it possible to modify events in order to suit the needs of the training environment. Methods were developed for designing meaningful scenario development on runway incursions on the basis of analysis of ASRS reports. It is noted that, while the development of interactive training tools using the ASRS and other data bases holds much promise, the design and production of interactive video programs and laser disks are very expensive. It is suggested that this problem may be overcome by sharing the costs of production to develop a library of materials available to a broad range of users. I.S.

A90-26307#
ATC CONTROL AND COMMUNICATIONS PROBLEMS - AN OVERVIEW OF RECENT ASRS DATA

ROWENA MORRISON and R. H. WRIGHT (Battelle Aviation Safety Reporting System Program Office, Mountain View, CA) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 2. Columbus, OH, Ohio State University, 1989, p. 902-907.

This paper examines the ATC control and communications problems, with special attention given to correlating the experience level of the controller and the incident occurrences. The types of safety incidents occurring in the NASA Aviation Safety Reporting System (ASRS) data set and the most frequently occurring controller errors in the high work-load situations are identified, and the specific work-load and environmental factors associated with these errors were correlated with pilot errors that may have preceded or predisposed the air traffic controller's errors. The implications of findings in regard to current ATC procedures and policies are assessed. I.S.

A90-26308#
WHERE'S THE WORKLOAD IN AIR TRAFFIC CONTROL?

ELIZABETH D. MURPHY, RAY A. REAUX, LISA J. STEWART (CTA, Inc., McLean, VA), WILLIAM D. COLEMAN (Hewlett-Packard Co., Santa Clara, CA), and KARIN BRUCE (James Martin Associates, Reston, VA) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 2. Columbus, OH, Ohio State University, 1989, p. 908-913. refs
(Contract DTRS57-86-C-00101)

To meet projected demands for the ATC services, the NASA plan calls for the increased automation of domestic air traffic control by the year 2000. This paper considers the methodology developed for quantifying and assessing the effects of future transition states of the ATC system on the work load of the domestic controller. Two future transition states were selected to demonstrate a proof-of-concept. The Advanced Automation System (AAS) will incorporate the conflict-alerting capabilities of the first phase of the AERA (advanced en route air traffic control) software. The second phase of the AERA software will provide the air traffic controller with automated conflict-resolution capabilities. A controller work-load model (CWM), developed to provide a common framework for comparing the ATC work load across different transition states, is described. I.S.

A90-26309#
MULTIDIMENSIONAL SCALING ANALYSIS OF SIMULATED AIR COMBAT MANEUVERING PERFORMANCE DATA. II - A FOLLOW-ON STUDY

RONALD J. POLZELLA (Dayton, University, OH) and GARY B. REID (USAF, Armstrong Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 2. Columbus, OH, Ohio State University, 1989, p. 920-925. refs

Multidimensional scaling (MDS) was applied to performance data obtained from expert and novice pilots during simulated air-to-air combat. The analyses revealed the principal performance dimensions to be TACTICAL POSITION (offensive versus defensive). TACTICS ('energy' versus 'angle'), and TYPE OF MANEUVERING (low energy versus high energy). High-skilled combat performance was found to be dependent on the interaction between position advantage, intelligent management of kinetic and potential energies, and maneuverability. Author

A90-26567
TRANSPARENCY AND COHERENCE IN HUMAN MOTION PERCEPTION

G. R. STONER, T. D. ALBRIGHT (Salk Institute for Biological Studies, La Jolla, CA), and V. S. RAMACHANDRAN (California, University, La Jolla) Nature (ISSN 0028-0836), vol. 344, March 8, 1990, p. 153-155. Research supported by NIH and USAF. refs
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When two independently moving gratings are superimposed, the human visual system tends to see the gratings cohere amd move unambiguously in a single direction (pattern motion) instead of moving independently (component motion). It is reported here that the tendency to see pattern motion depends very strongly on the luminance of the intersections where the gratings overlap relative to that of the gratings in a way that closely parallels the physics of transparency. When the luminance of these regions is chosen appropriately, pattern motion is destroyed and replaced by the appearance of two transparent gratings moving independently. The observations imply that motion detecting mechanisms in the visual system must have access to tacit 'knowledge' of the physics of transparency and that this knowledge can be used to segment the scene into different objects. The same knowledge could, in principle, be used to avoid confusing shadows with real object boundaries. C.D.

A90-27406* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
MAINTAINING HUMAN PRODUCTIVITY DURING MARS TRANSIT

IRVING C. STATLER and CHARLES E. BILLINGS (NASA, Ames Research Center, Moffett Field, CA) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 11 p. refs
(SAE PAPER 891435) Copyright

This paper addresses the special nature of the human-machine relationship during a trip to Mars. In particular, the potential for monotony and boredom during a long-duration space voyage and the effect on motivation and productivity can be important considerations to the health and welfare of the crew. For the voyage to Mars, a design may be considered that will purposefully maintain some level of workload for the crew as a preventive measure for the deterioration of productivity that comes with boredom. This paper speculates on these considerations, on the appropriate level of workload for maximum productivity, and on what might be done during the mission to alleviate the problems caused by monotony and boredom. Author

A90-27635* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
ANGULAR VELOCITY DISCRIMINATION

MARY K. KAISER (NASA, Ames Research Center, Moffett Field, CA) Perception and Psychophysics (ISSN 0031-5117), vol. 47, 1990, p. 149-156. refs
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Three experiments designed to investigate the ability of naive observers to discriminate rotational velocities of two simultaneously viewed objects are described. Rotations are constrained to occur about the x and y axes, resulting in linear two-dimensional image trajectories. The results indicate that observers can discriminate

angular velocities with a competence near that for linear velocities. However, perceived angular rate is influenced by structural aspects of the stimuli. C.D.

A90-27636* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
THE METHOD OF CONSTANT STIMULI IS INEFFICIENT
ANDREW B. WATSON (NASA, Ames Research Center, Moffett Field, CA) and ANDREW FITZHUGH (Hewlett-Packard Laboratories, Palo Alto, CA) Perception and Psychophysics (ISSN 0031-5117), vol. 47, no. 1, 1990, p. 87-91. refs
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Simpson (1988) has argued that the method of constant stimuli is as efficient as adaptive methods of threshold estimation and has supported this claim with simulations. It is shown that Simpson's simulations are not a reasonable model of the experimental process and that more plausible simulations confirm that adaptive methods are much more efficient that the method of constant stimuli. Author

N90-17275# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Aerospace Medical Panel.
HUMAN BEHAVIOUR IN HIGH STRESS SITUATIONS IN AEROSPACE OPERATIONS
Jun. 1989 200 p In ENGLISH and FRENCH Symposium held in Hague, Netherlands, 24-28 Oct. 1988
(AGARD-CP-458; ISBN-92-835-0517-4) Copyright Avail: NTIS HC A09/MF A02; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

These Proceedings include the Technical Evaluation Report, the Keynote Address, 20 papers and ensuing discussions from the Symposium sponsored by the AGARD Aerospace Medical Panel held in The Hague, The Netherlands from 24 to 28 October 1989. As the human operator is more and more clearly shown to be the limiting factor in the operational performance of modern aerospace systems, more and more rigorous selection criteria must be applied for psychological as well as medical selection of aircrew. This Symposium examined this problem from the point of view of human behavior in high stress situations specifically looking at incident and accident experience, personality traits, responses to stress and prediction of behavioral responses. These proceedings will be of interest to those involved with the psychological selection and/or assessment of aircrew.

N90-17276# Royal Air Force Inst. of Aviation Medicine, Farnborough (England).
CAUSES OF AIRCREW ERROR IN THE ROYAL AIR FORCE
J. W. CHAPPELOW *In* AGARD, Human Behaviour in High Stress Situations in Aerospace Operations 9 p Jun. 1989
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One hundred and forty nine military flying accidents were investigated by psychologists. Inspection of the data collected revealed that nearly half of the accidents involved inadequacies in equipment design, training or administration. Cognitive failure was a major cause of aircrew error and was more often associated with underarousal than with overarousal. Overarousal made a significant contribution to aircrew error, but largely as a secondary factor, i.e., it was generally a consequence of mechanical problems, disorientation, or prior mishandling of the aircraft. Personality factors also made a significant contribution, and the data suggest two distinct types of problem. Life stress and high workload appeared not to play a major part in stress-related accidents. Fatigue was not a major factor, but was closely associated with cognitive failure. Author

N90-17277# Belgian Air Force, Brussels. Medical Aerospace Center.
REVIEW OF SERIOUS AIRCRAFT ACCIDENTS IN THE BELGIAN AIR FORCE: CAUSES AND COMPARISON WITH SELECTION DATA Report, Sep. 1973 - Jun. 1986 [REVUE DES ACCIDENTS AERIENS GRAVES A LA FORCE AERIENNE BELGE: CAUSES ET COMPARAISON AVEC QUELQUES DONNEES DE SELECTION]
J-C. GENON, P. TECK, and P. VANDENBOSCH *In* AGARD, Human Behaviour in High Stress Situations in Aerospace Operations 12 p Jun. 1989 In FRENCH
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Methods used by the Belgian Air Force for the analysis of aircraft accidents are outlined. Accident base data and the causal factors employed in the analyses are described. Causal factors are grouped into three categories including human factors, inexperience, and external (non-human) factors. Accident data are presented for each factor in isolation and factors conjugated with other factors. The relation between causal factors and pilot selection data (psychometric and personality) is also examined. Transl. by M.G.

N90-17278# Royal Norwegian Air Force, Blindern. Inst. of Aviation Medicine.
ACCIDENTS IN FIGHTER AIRCRAFT CAUSED BY HUMAN FACTORS. WHY DO THEY OCCUR
GRETE MYHRE *In* AGARD, Human Behaviour in High Stress Situations in Aerospace Operations 6 p Jun. 1989
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Pilots in fighter aircraft represent a rigorously selected group both physically and psychologically. Still, more than half of the incidents and accidents involving these aircraft can be attributed to human factor overloading, even during routine operations. In what way is this high number of human error accidents explained, considering the fact that the psychological selection tests have never been more sophisticated and thorough than they are today. Possible reasons for and answers to this question are examined. Author

N90-17279# Aeronautical Research Inst. of Sweden, Stockholm.
PSYCHOLOGICAL REACTIONS OF PILOTS INVOLVED IN ACCIDENTS IN THE SWEDISH AIR FORCE
KRISTINA POLLACK *In* AGARD, Human Behaviour in High Stress Situations in Aerospace Operations 4 p Jun. 1989
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Every aircraft accident could be described as a unique life-event, complex in nature with varying causes and effects. Studies of the emotional consequences of accidents in military aircrew are sparse. Data obtained from pilots involved in accidents was examined to learn their psychological reactions to accidents. As a part of the air safety program in the Swedish Air Force retrospective information was obtained from 40 pilots who had survived military aircraft crashes during 1978 to 85. In order to collect objective and subjective data all pilots completed comprehensive questionnaires covering the following areas: (1) the air crash; (2) how events happened during the ejection and the following rescue; (3) the medical consequences and the emotional sequels, i.e., reactions, thoughts and mood after survival; and (4) attitudes towards resuming flying duty. Free comments were encouraged in the responses to questions concerning desired psychological support and rehabilitation. Results are examined. Author

N90-17280# *Israeli Air Force Aeromedical Center, Tel Hashomer.* Psychology and Psychiatry.
THE DESCENT FROM THE OLIMPUS: THE EFFECT OF ACCIDENTS ON AIRCREW SURVIVORS
I. BARNEA *In* AGARD, Human Behaviour in High Stress Situations in Aerospace Operations 9 p Jun. 1989
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Limited research has been done studying the effects of flying accidents on surviving aircrews (pilots and navigators). In general, it consists of case studies conducted by squadron medical staff focusing on serious problems developed by the pilot and/or his family as a result of the accident. The most significant finding of this research has been that the return to flying following an accident in flight is not as simple as it may appear. To consider an accident as part of the training routine and to expect return to normal activities as if nothing out of the ordinary has occurred is to ignore the legitimate emotional reactions of the aircrew and the possible effects of those reactions on the development of physical and psychological symptoms including deterioration of flying performance, motivation and commitment. Return to flying with hidden, untreated symptoms is likely to aggravate them, prolong their resolution or even make them irreversible resulting in the loss of flight personnel. Two objectives were persued: (1) to improve the understanding of the relationship between a flying accident, the resulting emotional reactions and their effect on performance levels; and (2) to develop an effective intervention procedure to enable the accident survivors to return quickly to preaccident functioning, both emotionally and professionally. Several aircrew survivors of serious flying accidents in the past five years participated in a research conducted by a psychologist using a structured interview especially developed for the present study. Results of the interview showed that 44 percent of the survivors reported a decrease in their flight performance and feeling toward flying than prior to the accident. Author

N90-17281# Air Force Human Resources Lab., Brooks AFB, TX. Personnel Research Psychologist.
PERSONALITY CHARACTERISTICS OF USAF PILOT CANDIDATES
FREDERICK M. SIEM *In* AGARD, Human Behaviour in High Stress Situations in Aerospace Operations 7 p Jun. 1989
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To examine the utility of personality measures for enhancing current selection methods, a computerized personality inventory was administered to a sample of USAF pilot candidates prior to flying training. Analysis of the data suggested that two of five personality factors were associated with training outcomes, and that one of the measures added predictive utility to test scores currently used for pilot selection. Candidates who were self-confident and not dogmatic manifested higher graduation rates than pilot candidates who were either less self-confident or more dogmatic (less flexible in their values). For a subset of respondents, performance scores were available for two phases of training. Examination of the data indicated that personality characteristics (depression, activity level) that did not differentiate training graduates from non-graduates were associated with better performance in two phases of flight training. In contrast, characteristics on which graduates and non-graduates differed (self-confidence, values flexibility) did not appear to be associated with performance scores during training. The main conclusion from this research is personality measures can contribute predictive utility to a pilot selection system over and beyond that displayed by currently operational aptitude measures. A second conclusion is that careful consideration must be made in the selection of both predictor and criterion variables in quantifying the relationships best suited for determining operational utility of personality measures. Author

N90-17282*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
LEADER PERSONALITY AND CREW EFFECTIVENESS: FACTORS INFLUENCING PERFORMANCE IN FULL-MISSION AIR TRANSPORT SIMULATION
THOMAS R. CHIDESTER and H. CLAYTON FOUSHEE *In* AGARD, Human Behaviour in High Stress Situations in Aerospace Operations 9 p Jun. 1989
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A full mission simulation research study was completed to assess the potential for selection along dimensions of personality. Using a selection algorithm described by Chidester (1987), captains were classified as fitting one of three profiles using a battery of personality assessment scales, and the performances of 23 crews led by captains fitting each profile were contrasted over a one and one-half day simulated trip. Crews led by captains fitting a Positive Instrumental Expressive profile (high achievement motivation and interpersonal skill) were consistently effective and made fewer errors. Crews led by captains fitting a Negative Communion profile (below average achievement motivation, negative expressive style, such as complaining) were consistently less effective and made more errors. Crews led by captains fitting a Negative Instrumental profile (high levels of Competitiveness, Verbal Aggressiveness, and Impatience and Irritability) were less effective on the first day but equal to the best on the second day. These results underscore the importance of stable personality variables as predictors of team coordination and performance. Author

N90-17283# Aerospace Medical Research Labs., Wright-Patterson AFB, OH. Human Engineering Div.
REACTIONS TO EMERGENCY SITUATIONS IN ACTUAL AND SIMULATED FLIGHT
GLENN F. WILSON, JUNE SKELLY, and BRADLEY PURVIS *In* AGARD, Human Behaviour in High Stress Situations in Aerospace Operations 15 p Jun. 1989
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Four emergency situations occurred during inflight and simulated air-to-ground training missions. Heart rate data were recorded from the pilots as part of a study designed to determine the effects of mission segment and flight position. A 50 percent increase in heart rate was found to occur only during actual flight but not during simulated flight emergencies. Heart rate variability decreased in all cases but to a greater extent during the inflight emergencies. Author

N90-17284# Illinois Univ., Urbana-Champaign. Inst. of Aviation.
EXPERTISE, STRESS, AND PILOT JUDGMENT
CHRISTOPHER D. WICKENS, BARBARA BARNETT, ALAN STOKES, TOM DAVIS, JR., and FRED HYMAN *In* AGARD, Human Behaviour in High Stress Situations in Aerospace Operations 9 p Jun. 1989
(Contract C87-101376-2)
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Two studies are described of pilot judgment, examining the effects of stress and of expertise. Both studies were carried out on a computer-based aviation decision making simulation called MIDIS. In the first study the cognitive abilities of 40 instrument rated pilots, 20 novices and 20 experts were assessed. These pilots then flew the MIDIS simulator on a simulated cross country flight during which their performance on a number of in-flight decisions was assessed. Experts were more confident than novices, but did not perform more optimally. The pattern of ability differences that predicted novice performance was different from that which predicted expert performance. In the second study, 10 instrument-rated pilots flew a different flight on MIDIS under conditions of stress (imposed by time pressure, noise, financial

risk, and task loading), while 10 subjects flew in a nonstressed control condition. Stress had different effects on different kinds of decision problems. It degraded performance on those problems imposing high demand on working memory, but left unaffected those problems imposing high demand on the retrieval of facts from long term memory. The results are discussed in terms of the commonalities between the effects of expertise and stress, on the mechanisms of working memory and long term memory in pilot judgment. Author

N90-17285# Norwegian Underwater Technology Center Ltd., Laksevaag.
STRESS AND PERFORMANCE DURING A SIMULATED FLIGHT IN A F-16 SIMULATOR
RAGNAR J. VAERNES, MARIT WARNCKE, GRETE MYHRE, and ASBJORN AAKVAAG *In* AGARD, Human Behaviour in High Stress Situations in Aerospace Operations 9 p Jun. 1989 Prepared in cooperation with Institute of Aviation Medicine, Oslo, Norway
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Sixteen Norwegian F-16 pilots (average age = 24.2 years, average experience = 2.2 years) were tested before, during and after a 90 min flight in a F-16 simulator. During the flight different emergency operations and landings in difficult weather conditions had to be performed. The pilot performance was logged continuously during the flight (Accepted/Not accepted). Heart rate (HR)/heart rate variability (HRV) was monitored continuously. Saliva for cortisol analysis and urine for catecholamine analysis were sampled before and after the flight. Tests of anxiety (state and trait) and defense mechanisms (Plutchik's Life Style Index, LSI) were administered. In addition to the pilots' test results on Krag's Defense Mechanism Test (DMT), results on psychomotor performance from the selection period were used. The endocrine and the HR-results indicated that the pilots were very activated during the flight. A HR of 120 beats/min was registrated. There were significant correlations between endocrine levels and not-accepted performance. Pilots with high defense mechanisms were significantly less activated on HRV, but had more pilot errors. Pilots with high defense considered simulator training as less important and they also trusted more the instruments in the aircraft. There was a significant correlation between high defense and number of near miss episodes during real flights. The results confirm previous studies which have shown that high defense correlates both to endocrine activation and impaired performance during stress in high risk occupations. Author

N90-17286# Civil Aeromedical Inst., Oklahoma City, OK.
PERFORMANCE RECOVERY FOLLOWING STARTLE: A LABORATORY APPROACH TO THE STUDY OF BEHAVIORAL RESPONSE TO SUDDEN AIRCRAFT EMERGENCIES
RICHARD I. THACKRAY *In* AGARD, Human Behaviour in High Stress Situations in Aerospace Operations 7 p Jun. 1989
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The use of response/recovery to auditory startle as a laboratory technique for simulating some of the principal aspects of the initial shock phase of sudden emergency situations is examined. It is submitted that auditory startle, with its unexpectedness, pronounced autonomic reaction, fear-like subjective experience, and frequent behavioral disruption, approximates the response pattern to be expected in the initial shock phase of sudden traumatic emergencies, and that by studying the time course of performance recovery following startle, as well as individual differences in response/recovery, a better understanding may be gained of some of the variables related to extreme reactions displayed by individuals in real life emergency situations. Research studies on performance impairment/recovery following startle are reviewed. These studies include those dealing with initial reaction time to the startle stimulus itself, disruption and recovery rate of perceptual-motor (tracking) performance following startle, and the time-course of performance recovery in information processing tasks after exposure to startle. Data are also presented showing a relationship of several individual difference variables to performance response/recovery following startle. These variables include autonomic response to the startle stimulus and level of task proficiency prior to startle. Author

N90-17287# Spanish Air Force (23rd Wing), Talavera AFB.
PERIPHERAL NERVOUS VELOCITY OF CONDUCTION IN FIGHTER PILOTS
J. L. GARCIA ALCON, J. M. MORENO VAZQUEZ, J. E. CAMPILLO ALVAREZ, and A. GONZALEZ RONCERO (National Health Inst., Badajoz, Spain) *In* AGARD, Human Behaviour in High Stress Situations in Aerospace Operations 7 p Jun. 1989
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Fighter pilot is under an important stress because of his special professional activity. It origins an automatic response through neurohormonal mechanisms. The most important among these mechanisms is the catecholamins secretion. These hormones will produce very important changes in the general homeostasy. The peripheral nervous system and mainly its mielyn sheath, is highly sensitive to variations in the internal environment. When that sheath is damaged the rapidity of nervous impulse transmission decrease. The system for to know that injury, is through measuring of the nervous velocity of conduction. This work shows the abnormal behavior of sensitive nervous velocity of conduction in fighter pilots in depending of flight hours. The great consumption of oxygen could be the reason for that alteration. Authors have found an important increase in Catalase and Glutathione-Peroxidase, that enzymes are protective systems in front to oxidations. Author

N90-17288# University of Southern California, Los Angeles. Dept. of Human Factors.
TRAINING AND SELECTING INDIVIDUALS FOR HIGH LEVELS OF INFORMATION PROCESSING LOAD
DIANE DAMOS *In* AGARD, Human Behaviour in High Stress Situations in Aerospace Operations 5 p Jun. 1989
(Contract N00014-86-K-0119)
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Techniques are examined for training and selecting pilots to deal with high information processing loads. Models of human information processing are briefly reviewed, then four methods of selecting pilots who can process large amounts of information quickly are discussed. Three of these four methods (selection based on the Type A behavioral pattern, measures of specific timesharing abilities, and the specific multiple-task response strategy) are recommended either for immediate use or for more extensive evaluation. Automation, the development of timesharing skills, and the development of flexible visual scan patterns are techniques that could be used to increase a pilot's information processing rate. None of these techniques has a basic research data base sufficient for the development of operational training techniques. All three are, however, promising and should be pursued in a systematic fashion. Author

N90-17289# Naval Aerospace Medical Research Lab., Pensacola, FL.
PERSONALITY ASSESSMENT IN AVIATION SELECTION
DANIEL L. DOLGIN *In* AGARD, Human Behaviour in High Stress Situations in Aerospace Operations 7 p Jun. 1989
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A comprehensive review of the personality literature as it relates to aircrew selection was conducted. The purpose was to identify specific tests that warrant further research as potential prediction instruments. Aviation selection techniques in the U.S. Navy and U.S. Air Force were reviewed. Individual tests used in aviation selection are discussed in terms of their results. The advent of performance-based personality assessment in the 1970s is

examined, and implications for future test development are explored. The majority of personality instruments reviewed were invalid for pilot selection. In some cases, methodological difficulties may have obviated more promising results. Recommendations are made for continued research with several tests that appear to be both effective in pilot selection and psychometrically sound. Those recommended selection tests include the Defense Mechanism Test because of its effectiveness in predicting pilot training success and safety in the Swedish and Danish forces. The Personality Research Form is recommended due to both its psychometric construction and current research efforts that are ongoing in the Canadian Armed Forces and U.S. Air Force. The Locus of Control is also proposed for both closer and continued attention. Other recommended selection instruments include the Work and Family Orientation Questionnaire and Extended Personality Attributes Questionnaire. Safety in aviation is also addressed as a major, emerging area of interest in the 1980s. Author

N90-17290# Bergen Univ. (Norway). Dept. of Physiological Psychology.

ACTIVATION: POSITIVE AND NEGATIVE EFFECTS OF THE ALARM SYSTEM IN THE BRAIN

HOLGER URSIN *In* AGARD, Human Behaviour in High Stress Situations in Aerospace Operations 11 p Jun. 1989

There is hardly any human activity where the level of wakefulness may have so dramatic effects on performance with consequences for life and death, as aviation and other forms of rapid transportation. All aspects of the problem area seem to be present: boredom and lack of attention during long periods of routine operation, bursts of activity at top performance level, and the possibility that there are long term effects which may be harmful in the long run. Numerically land transport is by far the most dangerous and costly operation, counted in lives lost or invalids produced. However, the concern herein is aviation, but the factors involved are general psychological and physiological principles valid for many types of activity. The mechanisms are actually biologically general as well, and some of the relevant data derive from animal experimentation. The mechanisms are examined in detail. Author

N90-17291# Ministry of Defence, London (England).

THE TRIALS AND TRIBULATIONS OF RAF DEFENCE MECHANISM TESTING

G. J. WALKER-SMITH *In* AGARD, Human Behaviour in High Stress Situations in Aerospace Operations 6 p Jun. 1989

The Defense Mechanism Test (DMT) is a projective personality test that was devised in Sweden, in the 1950s. It was designed to identify how individuals cope with a threat and to assess what defence mechanisms are used to protect the individual in a stressful situation. Swedish validity studies have shown that the DMT can predict training wastage and pilot error flying accidents. Consequently the DMT has been used for pilot selection. The test has also been used for Air Force pilot selection in Norway, Denmark, Greece and the Netherlands and is undergoing trials in other countries. Since 1976 empirical investigations have been carried out to test the validity of using the DMT to select Royal Air Force (RAF) pilots. Owing to methodological inadequacies, early RAF trials proved inconclusive. However, in 1984 a DMT trial was set up where the Swedish method of testing was followed. DMT scores were collected from a sample of 253 pilot trainees and their flying training results and flying accident involvement are being monitored. So far this DMT trial has shown that the DMT scores fail to predict flying training performance. The discrepancy between the RSwAF results and the RAF findings is considered. Author

N90-17292# Institut d'Aeronomie Spatiale de Belgique, Brussels.

PRINCIPLE GUIDELINES FOR THE PSYCHOLOGICAL SCREENING OF CANDIDATE PILOTS FOR THE BELGIAN AIR FORCE [LIGNES DIRECTRICES PRINCIPALES FONDANT LA SELECTION PSYCHOLOGIQUE DES CANDIDATS PILOTES A LA FORCE AERIENNE BELGE]

J-C. GENON and P. VANDERBOSCH (Belgian Air Force, Brussels.) *In* AGARD, Human Behaviour in High Stress Situations in Aerospace Operations 5 p Jun. 1989 In FRENCH

Various psychological testing and screening methods employed by the Belgian Air Force for the selection of pilots are described. Emphasis is given to the description of guidelines for the candidate selection process. Selection criteria, interpretation of results, functional models, and the use of simulation are also addressed. Transl. by M.G.

N90-17293# Institute for Perception RVO-TNO, Soesterberg (Netherlands).

PREDICTION OF SUCCESS IN FLIGHT TRAINING BY SINGLE- AND DUAL-TASK PERFORMANCE

P. G. A. M. JORNA *In* AGARD, Human Behaviour in High Stress Situations in Aerospace Operations 10 p Jun. 1989

Advanced technology has changed the type and the amount of information a pilot has to process. The military pilot is particularly involved in performing multiple tasks under difficult working conditions. Some aspirant pilots are not able to finish advanced training, apparently for reasons of an insufficient multiple task performance. A reduction of such attrition is highly desirable to reduce the cost of training. A test based on dual-task performance was developed to investigate the trainability of aspirant pilots to perform under such demanding conditions. The dual-task was a combination of a pursuit tracking task with preview and a continuous memory task (CMT). Aspirant pilots practiced the tracking task and were tested under single- and dual-task conditions. Dual-task performance was expected to be related to pilot aptitude as assessed by other criteria. The results were validated against the level of pilot aptitude as assessed by traditional selection procedures, a flight simulator test and advanced flight training for the Lockheed Orion and the Westland Lynx helicopter. Successful aspirants, now operational pilots, were characterized by their excellent performance under dual-task conditions. Less successful aspirants performed less efficient under dual-task conditions as well as single-task conditions, depending on how soon they failed in the selection and training process. Prior flying experience did not influence tracking performance and was not found to be a critical factor in predicting success in advanced or operational flight training. Author

N90-17294# Naval Aerospace Medical Research Lab., Pensacola, FL.

PREDICTING AIR COMBAT MANEUVERING (ACM) PERFORMANCE

G. R. GRIFFIN *In* AGARD, Human Behaviour in High Stress Situations in Aerospace Operations 13 p Jun. 1989

A difficult aspect of predicting fleet pilot performance is acquiring meaningful and reliable, inflight criteria. Air Combat Maneuvering (ACM) performance was provided using performance-based laboratory tests and the VF-43 adversary squadron's grading of inflight ACM performance was evaluated in the Fleet Fighter ACM Readiness Program. In an initial evaluation, F-4 pilots performed in Fleet Fighter ACM Readiness exercises and completed performance-based perceptual motor and multitask tests. Results indicated that dichotic listening test measures, obtained during

multitask conditions, could be used to reliably predict ACM inflight criteria. Results assigned by VF-43 adversary personnel can be predicted reliably by an objective kill difference composite score and three subjective measures: situational awareness, mutual support, and energy management. These measures accounted for 78 percent of the variance with the OAG. A correlational analysis suggests that the VF-43 grading process is reliable and consistent. Author

N90-17295# Institute for Perception RVO-TNO, Soesterberg (Netherlands).
STANDARDIZED TESTS FOR RESEARCH WITH ENVIRONMENTAL STRESSORS: THE AGARD STRES BATTERY
L. C. BOER, E. W. FARMER, and GLENN F. WILSON (Aerospace Medical Research Labs., Wright-Patterson AFB, OH.) *In* AGARD, *Human Behaviour in High Stress Situations in Aerospace Operations* 16 p Jun. 1989
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Assessment of human cognitive performance under stress is highly desirable, but is hampered by lack of standardization. Most tasks used in stress research are based on the paradigms of Human Performance Theory, that are frameworks for the manipulation of variables, not yardsticks for assessing stressor effects. In consequence, the results of two different studies cannot be compared directly. Even if the studies used the same paradigm, the particular task may have differed on such variables as condition of testing, number of trials, amount of training, or type of stimuli. Thus, for applied work there is a need for standardization. The AGARD STRES battery (Standardized Tests for Research with Environmental Stressors) is described as proposed by AGARD. The battery consists of seven tasks based on widely-used paradigms. The seven tasks and a data-exchange format are described. Author

N90-17296# Environmental Research Inst. of Michigan, Ann Arbor.
SURVEY OF ERIM APPROACHES APPLICABLE TO SEMI-AUTOMATIC TARGET DETECTION AND CUEING FOR MULTISPECTRAL AND MULTISENSOR EXPLOITATION Final Report
LYNNETTE WOOD 25 Jul. 1989 80 p Sponsored by RADC Prepared for Pattern Analysis and Recognition Corp., New Hartford, NY
(Contract SC-88-0151-02)
(AD-A214241; ERIM-215400-1-F) Avail: NTIS HC A05/MF A01 CSCL 17/8

Tactical and strategic decisions must increasingly be made based on the aggregation and integration of information from various sources. Multiple sensors can be employed to provide a range of parameters which can aid in identifying enemy targets. The synergistic combination of data from these various sensors, as well as from other sources, can enhance a photointerpreter's ability to locate and identify targets. A semi-automatic multispectral multisensor system for target detection would be invaluable for this purpose. The Semi-Automated Multispectral/Multisensor Exploitation (SAMME) Project is an effort to develop computer assisted algorithms and display methods to aid interpreters in identifying targets in multispectral multisensor data. This report outlines approaches attempted at the Environmental Research Institute of Michigan (ERIM) which are relevant to the SAMME project. A series of over 200 ERIM documents were reviewed. Included in the review were internal memos, technical reports, white papers, proposals and journal articles published by ERIM employees which describe results of work done at ERIM. The report includes information on benefits and drawbacks of various approaches under different circumstances. However, this report is not a recommendation for a particular system, only a compendium of knowledge applicable to the task. GRA

N90-17297# Northeastern Univ., Boston, MA. Dept. of Psychology.
A MODEL FOR VISUAL ATTENTION Final Technical Report, 31 Jul. 1988 - 31 Jul. 1989
ADAM REEVES 1 Oct. 1989 4 p
(Contract AF-AFOSR-0172-87; AF PROJ. 2313)
(AD-A214505; AFOSR-89-1322TR) Avail: NTIS HC A01/MF A01 CSCL 06/4

Research has been undertaken in three areas concerning human visual attention: the AGM model for attention shifting, iconic memory and visual imagery. GRA

N90-17298# Pittsburgh Univ., PA. Learning Research and Development Center.
FEEDBACK EFFECTS IN COMPUTER-BASED SKILL LEARNING Final Report, 1986 - 1989
JOHN M. LEVINE and WALTER SCHNEIDER 12 Sep. 1989 69 p
(Contract N00014-86-K-0569; RR04206)
(AD-A214560) Avail: NTIS HC A04/MF A01 CSCL 05/6

This paper reports several experiments that investigated how performance feedback in a computer-based training environment affected students' acquisition of cognitive skills requiring substantial practice. College students worked on category-search or electronic troubleshooting tasks; problems were presented, responses were recorded, and performance feedback was given using microcomputer. We studied the impact of receiving information about: (1) temporal trends in one's own performance (i.e., intrapersonal feedback alone), and (2) temporal trends in both one's own and others' performance (i.e., joint intrapersonal and interpersonal feedback). In regard to intrapersonal feedback alone, we assessed how different types of absolute performance information (e.g., weighted vs. unweighted averages of reaction times on previous trials) affected students' learning. Results indicated that these manipulations had only weak effects. In regard to joint intrapersonal and interpersonal feedback, we assessed how different types of relative performance information (e.g., superiority vs. inferiority vis-a-vis others) affected students' learning. Here, evidence revealed that the type of feedback students received influenced how well they performed. It was suggested that the impact of intrapersonal and intrapersonal feedback will be affected by the amount of practice time needed to achieve proficiency. GRA

N90-17299# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
COMPLEXITY OF HUMAN LANGUAGE COMPREHENSION
ERIC S. RISTAD Dec. 1988 50 p
(Contract N00014-85-K-0124)
(AD-A214591; AI-M-964) Avail: NTIS HC A03/MF A01 CSCL 05/7

The goal of this research has been to understand the computational structure of principle-and-parameter linguistic theories: what computational problems do these theories pose and what is the underlying structure of those computations. The computational problem of human language comprehension is analyzed: what linguistic representation is assigned to a given sound. This language comprehension problem may be factored into smaller, interrelated (but independently stable) problems defined on partial phonological, morphological, and syntactic representations. For example, in order to understand a given sound, the listener must assign a phonetic form to the sound; determine the morphemes that compose the words in the sound; and calculate the linguistic antecedent of every pronoun in the utterance. The author proves that these and some other subproblems are all NP-hard, and that language comprehension is itself PSPACE-hard, according to current linguistic theory. GRA

N90-17300# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
THE PERCEPTUAL BUILDUP OF THREE-DIMENSIONAL STRUCTURE FROM MOTION
ELLEN C. HILDRETH, NORBERTO M. GRZYWACZ, EDWARD H.

ADELSON, and VICTOR K. INADA Aug. 1989 37 p
(Contract N00014-85-K-0124)
(AD-A214640; AI-M-1141; CBIP-M-20) Avail: NTIS HC A03/MF A01 CSCL 05/8

A set of psychophysical experiments that measure the accuracy of perceived 3-D structure derived from relative motion in the changing 2-D image is presented. The experiments are motivated in part by a computational model proposed by Ullman (1984), called the incremental rigidity scheme, in which an accurate 3-D structure is built up incrementally, by considering images of moving objects over an extended time period. The main conclusions are: (1) the human visual system can derive an accurate model of the relative depths of moving points, even in the presence of noise in their image positions; (2) the accuracy of the 3-D model improves with time, eventually reaching a plateau; and (3) the 3-D structure currently perceived appears to depend on previous 3-D models. Through computer simulations, the results are related of the psychophysical experiments with the predictions of Ullman's model. GRA

N90-17301# Naval Aerospace Medical Research Lab., Pensacola, FL.
DEVELOPMENT OF A PERFORMANCE-BASED TEST OF GAZE CAPABILITY: A THRESHOLD APPROACH Interim Report, Oct. 1986 - Oct. 1988
W. CARROLL HIXON 16 Oct. 1989 21 p
(AD-A214675; NAMRL-1345) Avail: NTIS HC A03/MF A01 CSCL 06/4

A high degree of gaze efficiency involving the precise coordinated motion of the head and eyes is particularly important to the aviator when making large shifts in gaze during the visual scan of cockpit instruments and avionics systems. For this reason, NAMRL has concentrated on the development of a relatively low-cost, performance-based measure of head/eye coordination that can be used to identify individual differences in the naval aviation population. Preliminary research has led to the development of a simplified test of gaze function identified as the Vestibulo Ocular-Reflex Performance Test (VORPET). The test is based on a Bekesy-type determination of the threshold time required for an individual to recognize and identify a fixed number of digits immediately following 90 deg shifts in gaze. The report provides a detailed description of the new test protocol and its design concepts along with the results of experiments comparing horizontal and vertical gaze shift performance, and test-retest learning effects. GRA

N90-17302# George Mason Univ., Fairfax, VA. Dept. of Psychology.
RECOGNITION OF ENVIRONMENTAL SOUNDS Final Report, 1 Jun. 1987 - 30 Jun. 1989
JAMES A. BALLAS Nov. 1989 16 p
(Contract N00014-87-K-0167)
(AD-A214942; ONR-TR-89-1) Avail: NTIS HC A03/MF A01 CSCL 23/2

The studies focused on two areas: acoustic and perceptual-cognitive factors related to sound identification; and the effects of context on identification of specific sounds. Results indicated that identification time and accuracy are related to causal uncertainty and to a construct called identifiability. Context was found to produce negative bias but not positive bias. GRA

N90-17303# Arizona Univ., Tucson. Dept. of Psychology.
MEASURES OF SUBJECTIVE VARIABLES IN VISUAL COGNITION Annual Report, 1 Sep. 1988 - 30 Sep. 1989
MARY A. PETERSON 30 Sep. 1989 120 p
(Contract AF-AFOSR-0075-89; AF PROJ. 2313)
(AD-A215084; AFOSR-89-1489TR) Avail: NTIS HC A06/MF A01 CSCL 05/8

A series of 10 experiments examined the subjective variables involved in the perceptual organization of shapes and objects; in particular, the role played by: (1) perceptual intentions, (2) structural knowledge, and (3) spatial attention. A series of experiments identified functional consequences of structural knowledge in both perception and imagery and functional differences between the two types of perceptual selectivity we examined. We found that: (1) prototypical shapes are perceived faster than quasitypical shapes (the goodness of the set between structural representations and these two types of shapes was assumed to differ), (2) structural knowledge regarding shape components is a necessary requirement for imagery reversal, (3) perceptual intentions are more effective when directed to prototypical rather than nonprototypical shapes, implicating structural knowledge as a mechanism through which perceptual intentions operate, and (4) spatial attention can be directed to parts of objects whereas perceptual intentions may operate holistically. In addition, the experiments provided some evidence that multiple shape representations are activated prior to shape recognition, and led to a new model of figure-ground organization. GRA

N90-17304# Kansas Univ., Lawrence. Dept. of Psychology.
MEASURING LEARNING ABILITY BY DYNAMIC TESTING Final Report, 1 Aug. 1988 - 31 Jul. 1989
SUSAN EMBRETSON 30 Sep. 1989 185 p
(Contract AF-AFOSR-0242-88; AF PROJ. 2313)
(AD-A215273; AFOSR-89-1511TR) Avail: NTIS HC A09/MF A01 CSCL 05/8

A criticism of traditional ability tests is that they are static, rather than dynamic, measures of intelligence. That is, the tests measure what the person has learned, but not necessarily the capacity to learn. This project developed two tests of learning ability, spatial learning ability and mathematical learning ability, based on cognitive theory. In these tests which consist of a pretest and two posttests, learning ability is the modifiability of a person's performance under conditions that change the cognitive load of the task, such as strategy training or cues. To solve some psychometric problems in measuring change (i.e., the inequivalencies of raw change at different initial performance levels and the unreliability of change scores), the multidimensional Rasch model for learning and change (Embretson, 1987; 1989A; 1989b) was used to estimate learning abilities. Further, the tests were counterbalanced for the stimulus features that influence processing difficulty to assure cognitive equivalency and to observe the impact of strategy training and cues on the mental models used in the tasks. Three goals were accomplished for each test: large sample data was obtained to calibrate the tests by the multidimensional Rasch model for learning and change, the construct validity of the learning ability measurements was examined and the cognitive theory underlying the tasks in each test was extended. GRA

N90-17305# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
STIMULUS FAMILIARITY DETERMINES RECOGNITION STRATEGY FOR NOVEL 3-D OBJECTS
SHIMON EDELMAN, HEINRICH BULTHOSS, and DAPHNA WEINSHALL Jul. 1989 23 p
(Contract N00014-88-K-0164; DACA76-85-C-0010)
(AD-A215274; AI-M-1138; CBIP-M-40) Avail: NTIS HC A03/MF A01 CSCL 06/4

Everyday objects are more readily recognized when seen from certain representative, or canonical, viewpoints than from other, random, viewpoints. We investigated the canonical views phenomenon for novel 3-D objects. In particular, we looked for the effects of object complexity and familiarity on the variation of response times and error rates over different views of the object. Our main findings indicate that the response times for different views become more uniform with practice, even though the subjects in our experiments received no feedback as to the correctness of their responses. In addition, the orderly dependency of the response time on the distance to a good view, characteristic of the canonical views phenomenon, disappears with practice. One possible interpretation of our results is in terms of a tradeoff between memory needed for storing specific-view representations of objects and time spent in recognizing the objects. GRA

N90-17306# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
PAYLOAD INVARIANT CONTROL VIA NEURAL NETWORKS: DEVELOPMENT AND EXPERIMENTAL EVALUATION M.S. Thesis
MARK A. JOHNSON Dec. 1989 157 p
(AD-A215740; AFIT/GE/ENG/89D-20) Avail: NTIS HC A08/MF A01 CSCL 12/9

One problem in robot control is how to obtain accurate high speed trajectory tracking when the payload varies throughout the performance of the task. A solution to the problem is one requirement for realizing a manipulator capable of duplicating human performance. A manipulator with the ability to emulate human performance is one prerequisite for achieving Air Force Robotic Telepresence program objectives. A new form of adaptive model-based control is proposed and experimentally evaluated. An Adaptive Model-Based Neural Network Controller (AMBNNC) uses multilayer perceptron artificial neural networks to estimate the payload during high speed manipulator motion. The payload estimate adapts the feedforward compensator to unmodeled system dynamics and payload variations. The neural nets are trained through repetitive training on trajectory tracking error data. The AMBNNC is experimentally evaluated on the third link of a PUMA-560 manipulator. Tracking performance is evaluated for a wide range of payload and trajectory conditions and compared to a non-adaptive model-based controller. The superior tracking accuracy of the AMBNNC demonstrates the potential of the proposed technique. GRA

N90-17613# Cranfield Inst. of Tech., Bedford (England). Applied Psychology Unit.
PASSENGER BEHAVIOUR IN AIRCRAFT EMERGENCIES INVOLVING SMOKE AND FIRE
CLAIRE HARRISON and HELEN MUIR *In* AGARD, Aircraft Fire Safety 14 p Oct. 1989
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A review of the accident literature has indicated that in aircraft emergencies involving smoke and fire both environmental and behavioral factors will influence passenger survival rates. These factors include the number of operational exits, the presence of toxic fumes, the extent to which anxiety, disorientation, feelings of depersonalization, panic, and behavioral inaction occur among the passengers. Furthermore, in situations in which life is placed under severe threat, in addition to the experience of fear, people will compete with each other in order to survive. As a consequence the orderly process of evacuation for which passengers are briefed, frequently breaks down and the behavior of passengers appears to be confused and disorderly. In an experimental program, a series of evacuation exercises were performed, in which incentive payments were made in order to introduce the element of competition which is known to lead to a disorderly evacuation in some aircraft accidents. Using this technique six configurations at the vestibule prior the type 1 exits, and seven seating configurations adjacent to the overwing exit were investigated. Author

N90-17615# Lufthansa German Airlines, Frankfurt (Germany, F.R.). Emergency Training.
FLIGHT CREW TRAINING FOR FIRE FIGHTING
ERNST-ALBRECHT LIMLEY *In* AGARD, Aircraft Fire Safety 6 p Oct. 1989
Copyright Avail: NTIS HC A18/MF A03; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

A description is contained of Lufthansa emergency training aspects for flight-and cabin crews in respect to fire fighting. It addresses topics as preventive measures, on board fire fighting equipment, measures in case of an on board fire, training for actual fire fighting, and future developments. Author

N90-18145 Washington Univ., Seattle.
SENSITIVITY OF THE PERIPHERAL VISION TO SIMULATED AIRCRAFT ASCENT AND DESCENT Ph.D. Thesis
DAVID ANDREW WHEELER 1989 50 p
Avail: Univ. Microfilms Order No. DA9000332

In an effort to decrease the central vision workload in pilots, aircraft designers are developing displays which present information in the peripheral vision. Described here are the results of experiments testing the effects of four display parameters on the ability of subjects to detect changes in upward and downward movement in the peripheral vision as a possible mode of information presentation. Subjects performed a tracking task in the central visual field. At the same time, in the peripheral vision (26 to 69 degrees visual angle), dots were moving toward the subjects, thus forming an information display. Thresholds for detecting changes in direction of dot movement in the peripheral display were measured. The results indicated that changes in direction of motion are detectable using only the peripheral vision and that threshold is highly dependent upon display parameters. These results suggest that, with appropriate display parameters, the peripheral vision is a possible location for a display of altitude change information in aircraft. Dissert. Abstr.

N90-18146# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Systems and Logistics.
A COMPARISON OF MICROCOMPUTER TRAINING METHODS AND SOURCES M.S. Thesis
DAVID M. KONDAS Sep. 1989 113 p
(AD-A216349; AFIT/GCA/LSQ/89S-7) Avail: NTIS HC A06/MF A01 CSCL 05/9

The purpose of this study was to evaluate the methods and sources of microcomputer training currently used in the Air Force in terms of their overall value to the job, training effectiveness, and level of competency achieved upon training completion. The three methods studied were classroom instruction, video-based training, and computer-based training (CBT). The three sources studied were in-house training functions, government-contracted training, and private (e.g., colleges and universities). One hundred and fifty-one government employees rated each method and source of PC training they had experienced. Classroom training was found to be the most often used and the most popular method of PC training, regardless of source. The preference of delivery method was classroom, CBT, then video-based training, regardless of source. GRA

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MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

A90-23898#
CONCEPT DESIGN OF THE SPECIAL PURPOSE DEXTEROUS MANIPULATOR FOR THE SPACE STATION MOBILE SERVICING SYSTEM
H. BORDUAS, D. GOSSAIN, A. KONG, E. QUITTNER, and D. SHAFFER (Spar Aerospace, Ltd., Mississauga, Canada) Canadian Aeronautics and Space Journal (ISSN 0008-2821), vol. 35, Dec. 1989, p. 197-204.

The Special Purpose Dexterous Manipulator (SPDM), Canada's contribution to the International Space Station, is discussed, emphasizing its mechanical aspects. The principal SPDM requirement pertaining to functions, design driving subtasks, reach, force/moment application, handling capabilities, and control modes are examined. The control design for the overall configuration, base, central body, arms, mounting structure, tool change out-mechanisms, tools, and thermal protection system is described.

Special features pertaining to the joint drives, commonality items, multiple functions, maintainability, and fault tolerance are addressed. C.D.

A90-23911*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
NASA'S FIRST DEXTEROUS SPACE ROBOT
HARRY G. MCCAIN (NASA, Goddard Space Flight Center, Greenbelt, MD) Aerospace America (ISSN 0740-722X), vol. 28, Feb. 1990, p. 12-15.
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NASA is developing the Flight Telerobotic Servicer (FTS), a robotic device that can be teleoperated under constant command of a human operator or run by itself under human supervision. Plans call for the FTS to assist the astronauts in the assembly, maintenance, servicing, and inspection of Space Station Freedom. The FTS project is driven by five major objectives: to reduce Space Station dependence on crew EVA, improve crew safety, enhance crew utilization, promote remote servicing capabilities for platforms, and accelerate technology transfer from research to U.S. industry. Another part of the FTS project is a ground system that will support operations and system evolution. Not only will the FTS provide a needed operational capability during the assembly and operation of Space Station Freedom, it will also provide an expanding foundation for proving more advanced robotic and telepresence concepts in space. R.E.P.

A90-23912#
DESIGN OVERVIEW
JAMES W. LOWRIE (Martin Marietta Corp., Astronautics Group, Denver, CO) Aerospace America (ISSN 0740-722X), vol. 28, Feb. 1990, p. 15, 16, 18, 20.
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A design overview of the Flight Telerobotic System (FTS) is presented. The FTS has two manipulators, each with seven degrees of freedom (DOF). It also has one five-DOF attachment stabilization and positioning system. The manipulators are teleoperator-controlled in seven DOF. Safety software associated with avoiding collisions is separated onto a redundant controller and two data processors, providing two-fault tolerance. Simulators will provide a real-time graphic display of simulated telerobot operations. The telerobot promises to be a useful, reliable, and safe tool to assist the astronauts in performing assembly, maintenance, servicing, and inspection tasks on Space Station Freedom and the Space Shuttle. R.E.P.

A90-23913*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
FTS OPERATIONS
JAMES F. ANDARY, SANFORD W. HINKAL, and DENNIS HEWITT (NASA, Goddard Space Flight Center, Greenbelt, MD) Aerospace America (ISSN 0740-722X), vol. 28, Feb. 1990, p. 20, 21.
Copyright

The first planned use of the Flight Telerobotic Servicer (FTS) in the Space Station Freedom program is for the initial assembly of the station. Before the station is permanently manned, the FTS will operate out of the Shuttle bay. After initial assembly is complete, the 60-ft-long arm of the Canadian Mobile Servicing Center (MSC) will transport the FTS to the worksites. The FTS has three operating modes: dependent, transporter attached, and independent. Further details are given for each of these modes. In analyzing assembly operations, potential tasks were examined for their similarity to the six baseline FTS tasks. Operations will also include ground support for the servicer. Future tasks are being analyzed and verified by hardware performance in the lab. R.E.P.

A90-23914#
NASA/NBS REFERENCE MODEL
JAMES S. ALBUS and RONALD LUMIA (NIST, Robot Systems Div., Gaithersburg, MD) Aerospace America (ISSN 0740-722X), vol. 28, Feb. 1990, p. 21-23.
Copyright

The NASA/NBS Standard Reference Model (NASREM) Telerobot Control System Architecture defines the basic architecture for a robot control system capable of teleoperation and autonomous operation. The goal is to make it the standard for all robotic systems. The control system architecture is a three-legged hierarchy of computing models, serviced by a communications system and a global memory. Details are provided for the three legs of the system. The control architecture allows human operators, at any location, to supervise the telerobot and assume control at any level of the hierarchy. NASREM is being implemented in support of the Flight Telerobotic Servicer (FTS) project. It provides a framework for controlling the telerobot's manipulators, cameras, end effectors, and tools. Some details of the proposed FTS test flight program are also provided. R.E.P.

A90-23915*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
EVOLUTION AND ADVANCED TECHNOLOGY
STANFORD OLLENDORF (NASA, Goddard Space Flight Center, Greenbelt, MD), JACK E. PENNINGTON (NASA, Langley Research Center, Hampton, VA), and BERT HANSEN, III (JPL, Pasadena, CA) Aerospace America (ISSN 0740-722X), vol. 28, Feb. 1990, p. 23, 24, 30.
Copyright

The NASREM architecture with its standard interfaces permits development and evolution of the Flight Telerobotic Servicer to greater autonomy. Technologies in control strategies for an arm with seven DOF, including a safety system containing skin sensors for obstacle avoidance, are being developed. Planning and robotic execution software includes symbolic task planning, world model data bases, and path planning algorithms. Research over the last five years has led to the development of laser scanning and ranging systems, which use coherent semiconductor laser diodes for short range sensing. The possibility of using a robot to autonomously assemble space structures is being investigated. A control framework compatible with NASREM is being developed that allows direct global control of the manipulator. Researchers are developing systems that permit an operator to quickly reconfigure the telerobot to do new tasks safely. R.E.P.

A90-24022*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
MANUAL CONTROL OF THE LANGLEY LABORATORY TELEROBOTIC MANIPULATOR
WALTER W. HANKINS, III and RANDOLPH W. MIXON (NASA, Langley Research Center, Hampton, VA) IEEE, International Conference on Systems, Man, and Cybernetics, Cambridge, MA, Nov. 14-17, 1989, Paper. 7 p.

Langley's new Laboratory Teleoperator Manipulator (LTM) provides manual control of seven-degree-of-freedom, replica, force-reflecting, master/slave manipulator arms in two arms simultaneously. This paper describes the LTM, its installation, and plans for a comparable evaluation study of various control input devices to the system. The comparison includes control using the system's master arms, six-degree-of-freedom hand controllers, minimasters, and a force-reflecting hand controller. C.D.

A90-24801#
A SYSTEM FOR RECYCLING ORGANIC MATERIALS IN A MICROGRAVITY ENVIRONMENT
JUDITH FIELDER and NICKOLAUS E. LEGGETT IN: Space manufacturing 7 - Space resources to improve life on earth; Proceedings of the Ninth Princeton/AIAA/SSI Conference, Princeton, NJ, May 10-13, 1989. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 219-222. refs
Copyright

This paper presents an aerobic composting system for microgravity operation. The composting system processes human and plant wastes into a material that is a suitable growth medium for plants. A combination of forced and suction aeration control the flow of oxygen through the mass of composting material, the moisture content, and temperature of the material. The composting process consumes oxygen and produces carbon dioxide that is provided to the plant growing chambers. The composting will also

generate heat that must be removed from the composting area. The fully composted material is transferred from the composting chamber to a plant growth chamber where it is used as a growth medium for plants in a configuration that ensures the optimum aeration and water/nutrient supply for plant growth. Author

A90-24802*# National Aeronautics and Space Administration. John C. Stennis Space Center, Bay Saint Louis, MS.
BIOREGENERATIVE SPACE AND TERRESTRIAL HABITAT
B. C. WOLVERTON, REBECCA C. MCCALEB (NASA, John C. Stennis Space Center, Bay Saint Louis, MS), and WILLARD L. DOUGLAS (Sverdrup Technology, Inc., Bay Saint Louis, MS) IN: Space manufacturing 7 - Space resources to improve life on earth; Proceedings of the Ninth Princeton/AIAA/SSI Conference, Princeton, NJ, May 10-13, 1989. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 223-229. refs
Copyright

For 15 years, NASA has been involved in bioregerative component development for air, water, and waste treatment. The results of this work have been integrated in the completion of a novel facility called BioHome which incorporates all of the developed bioregenerative components for air, water, and nutrient recovery into a single habitat. The evaluation and refinement of BioHome's integrated component efficiencies will provide a test-bed for future systems to be used in long-term space travel. C.D.

A90-24803*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.
CONTROLLED ECOLOGICAL LIFE SUPPORT SYSTEM BREADBOARD PROJECT - 1988
W. M. KNOTT (NASA, Kennedy Space Center, Cocoa Beach, FL) IN: Space manufacturing 7 - Space resources to improve life on earth; Proceedings of the Ninth Princeton/AIAA/SSI Conference, Princeton, NJ, May 10-13, 1989. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 230-234.
Copyright

The Controlled Ecological Life Support System (CELSS) Breadboard Project, NASA's effort to develop the technology required to produce a functioning bioregenerative system, is discussed. The different phases of the project and its current status are described. The relationship between the project components are shown, and major project activities for fiscal years 1989-1993 are listed. The biomass production chamber to be used by the project is described. C.D.

A90-24804#
HUMAN IN CLOSED ECOLOGICAL SYSTEM
LINDA LEIGH (Space Biospheres Ventures, Oracle, AZ) IN: Space manufacturing 7 - Space resources to improve life on earth; Proceedings of the Ninth Princeton/AIAA/SSI Conference, Princeton, NJ, May 10-13, 1989. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 235, 236.
Copyright

The Biosphere II program to develop a closed ecological system modeling the earth is described. Research leading to the plans for the Biosphere project and the development of a test model to study the systems included in the project are reviewed. Experiments in which a human inhabited the closed ecological system are revewed and the test module is illustrated. R.B.

A90-24805#
METHODS OF CREATING BIOLOGICAL LIFE SUPPORT SYSTEMS FOR MAN IN SPACE
IOSIF GITEL'SON (AN SSSR, Institut Biofiziki, Krasnoyarsk, USSR) IN: Space manufacturing 7 - Space resources to improve life on earth; Proceedings of the Ninth Princeton/AIAA/SSI Conference, Princeton, NJ, May 10-13, 1989. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 237-239.
Copyright

The task of creating and operating an experimental ecosystem for man in space is discussed based on Soviet experimental results. An experimental biocomplex is described, including the functions of its different sections, the characteristics of its air, and the way that it produces nutritional biomass. The effects on the 'crew' of staying within the complex for varying periods of time are pointed out. C.D.

A90-25564
MAN-MACHINE INTERFACE PROBLEMS IN DESIGNING AIR TRAFFIC CONTROL SYSTEMS
V. DAVID HOPKIN (RAF, Institute of Aviation Medicine, Farnborough, England) IEEE, Proceedings (ISSN 0018-9219), vol. 77, Nov. 1989, p. 1634-1642. refs
Copyright

The author notes that workspace design requirements for air traffic control man-machine interfaces (MMIs) are generally orthodox, although the MMI must remain efficient throughout gross changes in staffing levels. Decisions during the MMI design largely determine how it can be used and what the controller must know about it. It is emphasized that human factor consequences should be considered when traffic-handling capacity is increased by cutting the time spent by the controller on each aircraft. It is concluded that MMI designs must be flexible enough to benefit from technological advances, yet continue to satisfy human needs. I.E.

A90-26020
ADVANTAGES OF A LOW-OXYGEN ENVIRONMENT IN SPACE CABINS
E. SHVARTZ (Rockwell International Corp., Space Transportation Systems Div., Downey, CA) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 61, March 1990, p. 272-276. refs
Copyright

The advantages of having a low-oxygen environment in space cabins are discussed. The major advantage is a sharply reduced fire hazard, which is a major threat in manned space flights. At 1 atm, for example, 15 percent O2 (9000 ft altitude equivalent) would not support most fires and could accommodate the crew with respect to hypoxia, decompression sickness (DCS), and other requirements. Chronic exposure to such a hypoxic environment (altitude acclimatization) could imporve major areas of crew health and safety, including alleviating deconditioning effects, decreasing susceptibility to DCS, and improving tolerance to severe hypoxia. Author

A90-26127#
CLOTHING MICROCLIMATE OF ANTI-EXPOSURE SUIT FOR AIRCREW
WATARU OGAWA, KEN SIMIZU, HIROKAZU OZAKI, and TSUTOMU KAGITA Japan Air Self Defense Force, Aeromedical Laboratory, Reports (ISSN 0023-2858), vol. 29, Dec. 1988, p. 143-155. In Japanese, with abstract in English. refs

The clothing microclimate of the JASDF standard and modified antiexposure suits is determined. Measurements of rectal temperature, skin temperature, percutaneous perspiration, and VO2 were made for three subjects in a chamber with air temperature of 20 C and 30 C for 90 min. The results show that the standard suits have a more advantageous microclimate than the modified suits. R.B.

A90-26183#
TRAINING PILOTS FOR THE AUTOMATED COCKPIT
ROBERT L. ARNOLD (United Airlines, Denver, CO) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 1. Columbus, OH, Ohio State University, 1989, p. 87-90.

Automatic flight systems, considered standard equipment on almost all new and future air transport aircraft, are designed to reduce crew workload, provide information to crews that previously was unavailable, promote standardization of cockpit configurations, and enhance economical operation. The considerable capabilities of modern automatic flight systems present unique challenges to pilots who must learn to use such systems, and unique challenges to instructional systems designed to teach these pilots their safe

and economical use. An approach to automatic flight training is presented along with considerations for design and related training research. It is concluded that automatic flight training is quantitatively different from traditional aircraft training. It is noted that as new cockpit displays and automatic flight systems evolve, new training techniques will have to be developed to prepare crews to effectively operate them. R.E.P.

A90-26188#
THE MANUFACTURER'S ROLE IN TRAINING PROGRAM DEVELOPMENT
J. KENNETH HIGGINS and ROLF J. BRAUNE (Boeing Commercial Airplanes, Seattle, WA) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 1. Columbus, OH, Ohio State University, 1989, p. 118-121.

The 747-400 is used as an example of how operational inputs, including training experiences, feed into a new design. The following operational inputs to new designs are reviewed: (1) flight deck design/crew operations, (2) the role of the project pilot, and (3) product reliability and maintainability/product safety. During the preliminary design phase, a flight deck project team considers all the inputs, prioritizes them, and trades the most important ones against cost and schedule constraints. At this point, pilot representatives from the FAA and the airlines are brought into the evaluation process to ensure the acceptability of the design to the line pilots and certification pilots. It is also during this phase that the training program design is finalized. The underlying philosophy for the development of the training program stresses the pilot's 'need to know'. This philosophy approach focuses on the knowledge required to operate the aircraft safely and efficiently. Once it is handed over to the airlines, it may be modified to fit individual airline requirements. When the aircraft enters operational service, the feedback loop is closed through the accumulation of day-to-day information on the effectiveness of the training program and design. R.E.P.

A90-26191#
DISPLAY PRINCIPLES, CONTROL DYNAMICS, AND ENVIRONMENTAL FACTORS IN PILOT PERFORMANCE AND TRANSFER OF TRAINING
GAVAN LINTERN, JONATHAN E. SIVIER (Illinois, University, Savoy), and STANLEY N. ROSCOE (ILLIANA Aviation Sciences, Las Cruces, NM) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 1. Columbus, OH, Ohio State University, 1989, p. 134-148. refs
(Contract N00014-87-K-0435)

Test results are presented for ab initio subjects in a fractional factorial, quasi-transfer experiment to examine the effects of four display factors, one control response factor, and one environmental factor on acquisition and transfer of aircraft landing skills. Transfer was measured from each of the experimental training conditions to a criterion condition with a conventional inside-out pictorial contact display, normal simulator control dynamics, and a five knot crosswind. Learning curves for initial training showed large performance differences favoring reduced bank control order and pictorial displays with augmented visual guidance and flight-path prediction. Transfer was better following training with pictorial versus symbolic displays, normal rather than reduced bank control order, no wind versus five knots of crosswind and with augmented flight-path predictions. The individual transfer effects of augmented pictorial versus symbolic guidance and prediction could not be conclusively evaluated by this experiment, but, overall, training with augmented pictorial displays proved superior to training in the criterion transfer condition from the outset. R.E.P.

A90-26199#
USE OF FLIGHT SIMULATORS TO INVESTIGATE THE EFFECTS OF ALCOHOL AND OTHER DRUGS ON PILOT PERFORMANCE. I
LEONARD E. ROSS and JAMES C. MUNDT (Wisconsin, University, Madison) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 1. Columbus, OH, Ohio State University, 1989, p. 197-202.
(Contract PHS-AA-06093)

Considering the difficulty, cost, and safety issues involved in presenting pilots with actual flight equipment problems where alcohol effects would most likely be found, there are obvious advantages to using flight simulators. How flight evaluation should be structured to permit accurate examination of the effects of alcohol on flight performance as well as actual pilot performance is detailed. Major sources of variability are indicated in both individual differences found in pilot performance and the general manner in which alcohol affects performance in complicated tasks such as piloting. R.E.P.

A90-26201#
INTERACTIVE, REAL-TIME FORMATION FLIGHT CONCEPT TRAINER
EDDY R. BILLMAN (USAF, Armstrong Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 1. Columbus, OH, Ohio State University, 1989, p. 209-214. refs

Results are reported from a preliminary pilot study investigating the utility of a computer-based concept trainer in teaching the geometry associated with the formation turning rejoin flight maneuver. During training, subjects viewed the lead aircraft from an out-the-front-window perspective. Also present on the display were the instantaneous predicted flight paths of both aircraft. The predicted paths moved dynamically with changes in control inputs, always showing the paths the aircraft would take if current control inputs were maintained. A control group trained without the benefit of the predictor paths, and two experimental groups flew with the paths presented either constantly or adaptively. All groups tested transfer on the control condition display. The small number of subjects in the study and high variability in performance did not allow conclusions from the data, but several lessons were learned about display format and task demands. Author

A90-26202*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
AN EVALUATIVE MODEL OF SYSTEM PERFORMANCE IN MANNED TELEOPERATIONAL SYSTEMS
RICHARD F. HAINES (NASA, Ames Research Center; Research Institute for Advanced Computer Science, Moffett Field, CA) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 1. Columbus, OH, Ohio State University, 1989, p. 215-220. refs

Manned teleoperational systems are used in aerospace operations in which humans must interact with machines remotely. Manual guidance of remotely piloted vehicles, controling a wind tunnel, carrying out a scientific procedure remotely are examples of teleoperations. A four input parameter throughput (Tp) model is presented which can be used to evaluate complex, manned, teleoperations-based systems and make critical comparisons among candidate control systems. The first two parameters of this model deal with nominal (A) and off-nominal (B) predicted events while the last two focus on measured events of two types, human performance (C) and system performance (D). Digital simulations showed that the expression $A(1-B)/C+D$ produced the greatest homogeneity of variance and distribution symmetry. Results from a recently completed manned life science telescience experiment will be used to further validate the model. Complex, interacting teleoperational systems may be systematically evaluated using this expression much like a computer benchmark is used. Author

A90-26205#
PATHWAY-IN-THE-SKY EVALUATION
JOHN REISING, KRISTEN BARTHELEMY (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, OH), and DAVID HARTSOCK (Midwest Systems Research, Dayton, OH) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20,

1989, Proceedings. Volume 1. Columbus, OH, Ohio State University, 1989, p. 233-238.

The pathway-in-the-sky concept provides a computer-generated path or roadway which depicts to the pilot the proper route to fly to and from the target area. The idea behind the pathway is that the pilot will be able to preview the path ahead and, therefore, anticipate changes in altitude and/or heading. The purpose of this study was to evaluate the effectiveness of the pathway format versus a HUD format when flying a preprogrammed route and to compare a three-dimensional stereo version of the pathway to a two-dimensional version. Results show that the main reason for the path's advantage over the HUD was that the pilot could view the path in the distance and anticipate the turns, climbs, and dives. In the HUD display, the inverted 'T' depicted only the route location at a given time, thus the pilot could not anticipate what would happen next. R.E.P.

A90-26206#
SYMBOLOGY DEVELOPMENT FOR TACTICAL SITUATION DISPLAYS
JOHN K. SCHMIDT, TERESA A. BRANSCOME, and MARY E. DOMINESSY (U.S. Army, Human Engineering Laboratory, Aberdeen Proving Ground, MD) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 1. Columbus, OH, Ohio State University, 1989, p. 239-244. refs

The present study was conducted to examine pictorial, abstract, and arbitrary shape code as well as varied/double border, regular/reverse screen, and augmentation code effects on tactical symbol perception and discrimination. Perceptibility, symbol detection, recognition, and identification latency, were analyzed with nested one-factor ANOVAs. No statistical difference was found for detection and recognition, although there was one for identification. Discriminability, recognition, identification, and paired comparison errors were analyzed with confusion matrices and chi square tests. Confusions took distinct patterns, and perception and discrimination error distributions were not proportional to those expected by chance. The results indicate definite implications for establishing standardized guidelines for tactical symbology. R.E.P.

A90-26207*# Illinois Univ., Savoy.
FRAME OF REFERENCE FOR ELECTRONIC MAPS - THE RELEVANCE OF SPATIAL COGNITION, MENTAL ROTATION, AND COMPONENTIAL TASK ANALYSIS
CHRISTOPHER D. WICKENS, ANTHONY ARETZ (Illinois, University, Savoy), and KELLY HARWOOD (Computer Technology Associates, Inc., McLean, VA) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 1. Columbus, OH, Ohio State University, 1989, p. 245-250. refs
(Contract NAG2-308)

Three experiments are reported that examine the difference between north-up and track-up maps for airborne navigation. The results of the first two experiments, conducted in a basic laboratory setting, identified the cost associated with mental rotation, when a north-up map is used. However, the data suggest that these costs are neither large nor consistent. The third experiment examined a range of tasks in a higher fidelity helicopter flight simulation, and associated the costs of north-up maps with a cognitive component related to orientation, and the costs of track-up maps with a cognitive component related to inconsistent landmark location. Different tasks are associated with different dependence on these components. The results are discussed in terms of their implications for map design, and for cognitive models of navigational processes. Author

A90-26208#
ELECTROLUMINESCENT LIGHTS FOR FORMATION FLIGHTS
JOHN C. SIMONS (Systems Research Laboratories, Inc., Dayton, OH) and JEFFERY L. CRAIG (USAF, Armstrong Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 1. Columbus, OH, Ohio State University, 1989, p. 251-256. refs

This report documents the use of low intensity, electroluminescent strip lights on fighter, cargo, and bomber aircraft for flying close air support, refuel, and strategic bombing missions. The human factor issues included: (1) optimum sizes, shapes, and locations of lights for immediate and constant interpretation of attitude of lead aircraft; (2) cuing both a bearing and distance relationship between two aircraft; (3) the effects of turbulence, eye fatigue, and weather problems; and (4) deriving an efficient, least costly approach for designing a light pattern for a new aircraft and mission application. The lighting has been added to A-10, C-130, and B-52 aircraft for special night, low-level operations. Author

A90-26209#
PRINCIPLES OF DESIGN FOR COMPLEX DISPLAYS - A COMPARATIVE EVALUATION
SHAROLYN A. CONVERSE (North Carolina State University, Raleigh) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 1. Columbus, OH, Ohio State University, 1989, p. 257-262. refs

The flexibility of display design allows for new techniques to reduce mental workload in the cockpit and as a result, mental workload should be decreased. However, the success of integrated displays has been mixed. It is noted that while integrated displays have improved performance in some cases, several reports indicate no performance gain when integrated displays were substituted for nonintegrated displays. This study was conducted to evaluate the main and interactive effects of grouping principle, task type, and information format on the speed and accuracy of performance in a system state monitoring task. Results indicate that complex task performance is moderated by the interactive effects of grouping principle, information format, and task type. One implication of this finding is that deriving design principles from data obtained in univariate studies should be examined closely. It appears that multivariate studies are likely to generate more realistic and more reliable information. R.E.P.

A90-26211#
EVALUATION OF SIMULATION TECHNIQUES OF SYNTHETIC APERTURE RADAR IMAGES FOR INCLUSION IN WEAPON SYSTEMS TRAINERS
DEMARIS A. WIDMAN, DAVID C. HUBBARD (Dayton, University, OH), and PETER M. CRANE (USAF, Human Resources Laboratory, Williams AFB, AZ) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 1. Columbus, OH, Ohio State University, 1989, p. 269-275.

The Human Resources Laboratory/Operations Training Division (HRL/OT) located at Williams AFB, AZ, has developed the capability to simulate synthetic aperture radar (SAR) in its Advanced Visual Technology System (AVTS) of Ferguson et al. (1989). The current study was an evaluation of the shadow effects added during the final post-processing stage of simulated AVTS-generated SAR images. The quality of the shadows was manipulated directly with a variable low-pass filter and indirectly by changing other post-processor effects which affect the overall quality of the image (e.g., blur, noise, and receiver gain). Ratings from twenty SAR-experienced B1-B offensive systems operators revealed that the optimal fidelity of the simulated shadows depends on image location and the level of contrast present in the image. Author

A90-26212*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
COMPARISON OF THERMAL (FLIR) AND TELEVISION IMAGES
MICHAEL S. BRICKNER (NASA, Ames Research Center, Moffett Field, CA) and LOWELL E. STAVELAND (San Jose State University Foundation, CA) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings.

Volume 1. Columbus, OH, Ohio State University, 1989, p. 276-281. refs

The human eye is sensitive to electromagnetic radiation in the 0.4 to 0.7 micron band (light). Thermal imaging (TI) systems are sensitive to heat radiation in the infrared band (3-5 or 8-14 microns) and are capable of transforming the distribution of relative temperatures in a scene into a visible TV image. The present experiment was designed to investigate the impact of the difference between TIs and regular TV images on the detection and identification of natural and man-made targets. Parallel TV and TI videotapes were recorded during helicopter flights. Fifteen subjects who viewed both the TV and the TI images (separately), were asked to detect predefined targets and to identify features pointed out to them by the experimenter. In general, performance with TVs was superior to performance with TIs in terms of response times and errors. However, subjects required significantly less time to detect man-made objects with TIs than with TVs. The correlation between the performance of the same task with the two kinds of images was very low. The results are discussed in terms of image quality and in terms of humans' internal representations of natural categories. Author

A90-26213#
IS VERTIGUARD THE ANSWER?
JACOB NETZ and YOSSI SHUB (Israel Aircraft Industries, Ltd., Lod) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 1. Columbus, OH, Ohio State University, 1989, p. 282-287.

The VERTIGUARD is a new device developed to solve Type 11 spatial disorientation for installation in the Lavi fighter and achieved through the FBW system. Type II (recognized) is described as that in which the pilot is aware of the vertigo but is not able to control the aircraft due to the very strong distraction, as opposed to Type I (unrecognized) in which the pilot is not aware of being disoriented. It consists of a special software package operated by a button located in the cockpit and is an integral part of the aircraft digital flight control system. Human engineering factors and flight parameters have been applied, favoring the pilot approach rather than the system approach to the design. The VERTIGUARD button is located so that pressing it forces the pilot to release the stick. The autopilot then takes control and maneuvers the aircraft to straight and level flight. The pilot is able to regain control at any time by operating the stick. It is pointed out that operational experience will be needed to determine the total effectiveness of the system and where modifications may be required. R.E.P.

A90-26214#
READABILITY IMPROVEMENTS OF EMERGENCY CHECKLISTS
PATRICIA ANTERSIJN and HANS DE REE (KLM-Royal Dutch Airlines, Schiphol, Netherlands) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 1. Columbus, OH, Ohio State University, 1989, p. 288-295. refs

Emergency checklists used by KLM show various differences, dependent on aircraft type. It was decided to evaluate the current checklists and to establish new guidelines for the rewriting of emergency checklists. Test prints drawn from the literature on perception and information processing were evaluated by pilots of different aircraft types. An experiment was carried out to measure the readability of various letter types. The combined results were analyzed,leading to the following recommendations: (1) for letters and numerals the font Helvetica should be used; (2) for standard text a Corps 10 medium face letter should be used, while for text parts that need to be conspicuous bold face should be used; (3) text should be printed with black ink on white paper; (4) for the index the aircraft subsystems should be used in an alphabetical order; and (5) procedures for the index should be functionally grouped and large tab numbers must be printed for a group of procedures printed on one tab number. R.E.P.

A90-26215#
TIME-DEPENDENT SAMPLING AND TOUGH-INPUT ACCURACY - WHY THE 'FIRST TOUCH' IS DIFFERENT FROM THE 'FIRST KISS'
DENNIS B. BERINGER (New Mexico State University, Las Cruces) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 1. Columbus, OH, Ohio State University, 1989, p. 296-301. Research supported by McDonnell Douglas Helicopter Co. refs

Present aircraft applications of touch-panel technology have raised questions concerning input sampling strategies (first versus last point of contact) as influenced by technology type and the effect of flight gloves on system performance. This investigation examined these questions and found that first point of contact was generally more accurate than last point of contact, with error minimums occurring between these points. High-resolution infrared and higher-resolution resistive panels exhibited comparable task performance and the use of flight gloves produced performance comparable to and in some cases better than bare hands. Strategies for seeking minimum error are discussed. Author

A90-26216#
TOUCH-ACCESSED DEVICE ACCURACY IN THE COCKPIT - USING HIGH-RESOLUTION TOUCH INPUT
MARY JAMES-BOWMAN and DENNIS B. BERINGER (New Mexico State University, Las Cruces) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 1. Columbus, OH, Ohio State University, 1989, p. 302-306. refs

In the present study the effects of screen angle relative to line of sight and positioning of targets were examined with a high-resolution resistive touch input device thought to have minimal parallax. Results replicated earlier findings in that a 17-degree declination of the touch surface below orthogonal to line of sight induced a high-touch bias error of 9 pixels whereas orthogonality of the interface to line of sight virtually eliminated bias. Both software and behavioral compensation strategies are discussed. Author

A90-26217#
PILOT ASSESSMENT OF THE AH-64 HELMET MOUNTED DISPLAY SYSTEM
STEVEN HALE and DINO PICCIONE (Essex Corp., Alexandria, VA) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 1. Columbus, OH, Ohio State University, 1989, p. 307-312. refs (Contract DAAA15-88-C-0005)

While intensive research has been conducted regarding the operational problems associated with the use of HUDs, much less work has been performed to assess the operational effectiveness of the helmet-mounted display (HMD). The current research was conducted to evaluate the performance of the HMD system used by AH-64A Apache aviators. A survey was conducted consisting of 37 items which addressed various human factor engineering aspects of the helmet display unit (HDU) and related systems. The items are categorized into four basic topic areas: (1) size and distance perception, (2) FLIR image quality, (3) effects of monocular viewing, and (4) spatial disorientation. The results of the survey and pilot interviews are summarized in detail for each of the four topic areas, noting that all AH-64 aviators strongly feel that if HDU FLIR image resolution could be enhanced and the field of view increased, the system would be much more effective. R.E.P.

A90-26218
PILOT EVALUATION OF SELECTED COLORS AND SCALES USING A DIGITIZED MAP DISPLAY
J. S. ECKEL, P. C. MOLLENHAUER, and M. J. PATTERSON (General Dynamics Corp., Fort Worth, TX) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 1. Columbus, OH, Ohio State University, 1989, p. 313-318.

The GEC Avionics Digitized Color Map was evaluated as an information source in a digital map system (DMS). The effects of scale selection (500K and 1M), a magnification or zoom of 2X, and three color schemes were analyzed. Tests conducted on military aviators were studied and it was found that color allocation of features on present aeronautical maps can be improved through the application of digitized or digital CRT presentations; standardization of color tints for terrain elevations across map scales would be helpful for reducing pilot errors and workload. It was also determined that excessive display clutter must be addressed throughout the digital map's development process; the integration of the extensive amount of information presented to the pilot will require some form of declutter selection, default process, or automation. R.E.P.

A90-26219#
INSTRUMENT SCANNING AND SUBJECTIVE WORKLOAD WITH THE PERIPHERAL VISION HORIZON DISPLAY
DONALD HAMELUCK and PAUL STAGER (York University, Toronto, Canada) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 1. Columbus, OH, Ohio State University, 1989, p. 319-325. Sponsorship: Department of Supply and Services. refs
(Contract DSS-W7711-7-7004-01-SE)

The Peripheral Vision Horizon Display (PVHD) is an expanded artificial horizon line produced by sweeping a red laser beam across the instrument panel in front of the pilot. It is intended to provide the pilot with visual orientation information through peripheral vision so that this information is continually conveyed to the pilot, no matter where the pilot is looking. This study examines whether pilots' instrument scanning behavior, especially their reliance on the attitude indicator, was reliably altered when the PVHD was in operation during standard instrument approaches. Subjective assessments of workload during the approaches was also examined to determine whether general pilot mental workload was reduced during flight with the PVHD. Military pilots participated in all flight phases of the research projects. Detailed data, diagrams, and evaluations are presented. It is concluded that although possible decrease in visual workload and increased experience with the PVHD might result in better pilot acceptance of the display, the fact remains that other problems exist, most notably the possibility of display-control reversals. R.E.P.

A90-26220#
MULTISENSOR INTEGRATION - A METHODOLOGICAL STUDY
SUSAN F. SAVAGE (U.S. Navy, Naval Weapons Center, China Lake, CA) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 1. Columbus, OH, Ohio State University, 1989, p. 326-331.

The paper investigates target identification performance when information from two independent sources is available and evaluates two methodologies for comparing single-display and dual-display target identification accuracy. Simulated FLIR imagery was developed as an additional source of targeting information. The psychophysical analysis method was compared to a repeated measures ANOVA using the difference between dual and single display accuracy as the dependent measure. Four subjects were shown simulated range only radar (ROR) and simulated FLIR images of six U.S. and Soviet ships for this experiment. The subjects were shown undistorted versions of the ROR profile and the FLIR image of the target, but were not shown images of the distractors (distortion levels), nor were they told how many distractors were used. It is concluded that the ANOVA method is easier to implement, allows the complete crossing of distortion levels, gives a more comprehensive analysis of the dual display performance, and is sensitive to performance enhancement even if the single display performance is high. The psychophysical method suffers from theoretical and statistical complexity, unknown effects of nonmonotonic data, and the inability to correctly classify performance under certain conditions. Therefore the ANOVA method is preferred. R.E.P.

A90-26221
ARE TWO SOURCES OF COCKPIT INFORMATION BETTER THAN ONE?
S. J. SELCON and R. M. TAYLOR (RAF, Institute of Aviation Medicine, Farnborough, England) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 1. Columbus, OH, Ohio State University, 1989, p. 332-337. refs
Copyright

The paper presents an account of the nature and levels of processing involved when information from one source is integrated with a supposedly redundant secondary source to provide a performance gain in choice RT (reaction time) tasks. Three experiments are described which investigate this redundancy gain effect: (1) feedback to a direct voice input (DVI) system using bimodal (visual/verbal) presentation of simple printed digits/spoken numbers to establish the presence of cross-modal integrality; (2) using colors, words, and combinations of both with shared semantic associations to attempt to show whether or not redundancy gain occurs at the 'level of comprehension'; and (3) using warning 'icons' (pictorial representations of danger situations) and verbal warning messages. Results of the three experiments demonstrate that information, both within and between modalities, can be processed integrally to produce performance benefits. The combination of an attentional model approach with an underlying processing model (including an integrality component) should mean that greater accuracy and flexibility will be available to the human engineer in a priori considerations of information requirements and input/output modality demands. R.E.P.

A90-26223*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
PILOT RESPONSE TO AVOIDANCE REGIONS DEPICTED ON ALTERNATE TCAS II RESOLUTION ADVISORY DISPLAYS
ROBERT J. TUTTELL, KAREN L. MCNALLY, and SHERYL L. CHAPPELL (NASA, Ames Research Center, Moffett Field, CA) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 1. Columbus, OH, Ohio State University, 1989, p. 344-348.

The objective of this study was to examine pilot reactions to three versions of the resolution advisory (RA) display of the TCAS II. Two modifications to the current system were designed to test the hypothesis that a different lighting pattern might be more effective than the 'red-only' version currently in use. Grouped into three sets, 28 RA displays of the same color pattern ('red-only', 'red-and-green', and 'green-only') were presented to 36 volunteer pilots on an IRIS terminal. The results indicated that the red-and-green display caused the least errors and hastened a quicker response than did the red-only display. Further, a subjective evaluation revealed that the pilots preferred the red-and-green display over the other two options. The red-only display caused the most errors, including seven unnecessary maneuvers. Pilots also responded slowest to this display and it was the least preferred. Author

A90-26224*# Ohio State Univ., Columbus.
ENROUTE FLIGHT-PATH PLANNING - COOPERATIVE PERFORMANCE OF FLIGHT CREWS AND KNOWLEDGE-BASED SYSTEMS
PHILIP J. SMITH, ELAINE MCCOY, CHUCK LAYTON, and DEB GALDES (Ohio State University, Columbus) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 1. Columbus, OH, Ohio State University, 1989, p. 349-353. refs
(Contract NCA2-288)

Interface design issues associated with the introduction of knowledge-based systems into the cockpit are discussed. Such issues include not only questions about display and control design, they also include deeper system design issues such as questions about the alternative roles and responsibilities of the flight crew and the computer system. In addition, the feasibility of using enroute flight path planning as a context for exploring such research

questions is considered. In particular, the development of a prototyping shell that allows rapid design and study of alternative interfaces and system designs is discussed. Author

A90-26226#
PILOT TRAINING - ARTIFICIAL INTELLIGENCE VS. PILOT INTELLIGENCE
MICHAEL C. MORAN (Lockheed Aeronautical Systems Co., Marietta, GA) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 1. Columbus, OH, Ohio State University, 1989, p. 360-365. refs

This study centers upon the question of whether artificial intelligence is sustaining, or perhaps replacing pilot intelligence. It is suggested that a pilot's continuing dependence upon an artificial intelligence system, within the larger context of the operational in-flight environment, implies a scope of risk that has yet to be fully appreciated. It is perceived that a pilot develops a system knowledge level based upon his ability to formulate an accurate mental model of the system under operation. Exercising the mental model under in-flight (or simulated) conditions to include combinations of component failures and complete system failure assures maximum skill level, retention, and (hopefully) knowledge possession. Possession of this knowledge should allow for maintenance of an expert pilot. Expert system design should include the recognition that artificial intelligence applications will not presently supplant a pilot's situational awareness requirement based upon his own intelligence. R.E.P.

A90-26236*# Massachusetts Inst. of Tech., Cambridge.
A COMPARISON OF COMMUNICATION MODES FOR DELIVERY OF AIR TRAFFIC CONTROL CLEARANCE AMENDMENTS IN TRANSPORT CATEGORY AIRCRAFT
D. CHANDRA, S. R. BUSSOLARI, and R. J. HANSMAN (MIT, Cambridge, MA) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 1. Columbus, OH, Ohio State University, 1989, p. 433-438. refs
(Contract NAG2-12)

A user centered evaluation is performed on the use of flight deck automation for display and control of aircraft horizontal flight path. A survey was distributed to pilots with a wide range of experience with the use of flight management computers in transport category aircraft to determine the acceptability and use patterns as reflected by the need for information displayed on the electronic horizontal situation indicator. A summary of survey results and planned part-task simulation to compare three communication modes (verbal, alphanumeric, graphic) are presented. Author

A90-26242#
A METHODOLOGY FOR DETERMINING INFORMATION MANAGEMENT REQUIREMENTS FROM A CREW ORIENTED MISSION SCENARIO
DENNIS L. PRICE (Virginia Polytechnic Institute and State University, Blacksburg), DOUGLAS B. BEAUDET (Computer Technology Associates, Lanham, MD), GILBERT G. KUPERMAN, and DENISE L. WILSON (USAF, Armstrong Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 1. Columbus, OH, Ohio State University, 1989, p. 495-500.
(Contract F33615-85-D-0514)

The Crew Member Mission Scenario (CMS) used in this research describes crew activities during a realistic mission without defining or limiting itself to specific technologies or crew configurations. In order to identify mission requirements, crew information demands, information management requirements and human factors issues in this scenario, it was necessary to develop a disciplined scenario review technique. There were five basic steps used in this technique: (1) review scenario, (2) identify mission requirements, (3) identify informal demands, (4) identify information management requirements, and (5) identify human factors design and behavioral issues. In conclusion, a five step methodology, based upon the availability and use of a CMS document, was presented. The methodology used is a step beyond the typical human factors analysis in system design, because it is based upon a technology free approach which considers the human operator requirements before technology insertion begins, and it does so at the basic concept phase of system development. This methodology was applied to an existing CMS to demonstrate the methodology. These steps are proposed as precedent to technology insertion and fundamental to a systems design and development program which centers upon the operator's requirements to accomplish a given mission. R.E.P.

A90-26255#
DIFFERENCES IN COCKPIT COMMUNICATION
LEON D. SEGAL (Illinois, University, Urbana) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 2. Columbus, OH, Ohio State University, 1989, p. 576-581. refs

The purpose of this theoretical paper is to identify and call attention to effects of cockpit spatial layout on crew communication and subsequent task performance. The paper discusses the general role of nonverbal communication in crew tasks, how workspace spatial layout affects behavior, how semantics can emerge from behavior within a specified context, and how actions can serve as a context for the interpretation of verbal communication. Examples are initially taken from general crew task scenarios, and later focus on specific aircraft cockpit interactions. It is suggested that human factors include the effects of cockpit spatial layout on crew communication in their research effort, aiming to apply the results to cockpit designs and crew training programs. Author

A90-26260*# Army Aviation Systems Command, Moffett Field, CA.
COBRA COMMUNICATIONS SWITCH INTEGRATION PROGRAM
ROBERT J. SHIVELY, LORAN A. HAWORTH, ZOLTAN SZOBOSZLAY (U.S. Army, Aeroflightdynamics Directorate, Moffett Field, CA), and F. GERALD MURRAY (Sterling Software; NASA, Ames Research Center; Sterling Software, Moffett Field, CA) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 2. Columbus, OH, Ohio State University, 1989, p. 605-610. refs

The paper describes a design modification to reduce the visual and manual workload associated with the radio selection and communications tasks in the U.S. Army AH-1 Cobra helicopter. The modification involves the integration of the radio selection and microphone actuating tasks into a single operation controlled by the transmit-intercom switch. Ground-based and flight tests were conducted to evaluate the modified configuration during twelve flight tasks. The results show that the proposed configuration performs twice as fast as the original configuration. R.B.

A90-26276*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
APPARENT LIMITATIONS OF HEAD-UP-DISPLAYS AND THERMAL IMAGING SYSTEMS
MICHAEL S. BRICKNER (NASA, Ames Research Center, Moffett Field, CA) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 2. Columbus, OH, Ohio State University, 1989, p. 703-707. refs

A simulated helicopter flight through a slalom course was presented on a Silicon Graphics IRIS 3130. The display represented the major visual characteristics of thermal images. Subjects were asked to maintain a designated altitude, while flying a slalom course between regularly spaced pylons. The presence of some of the high frequency details in the image improved subjects' ability to reach and maintain the correct altitude. A head-up-display helped in maintaining altitude, but impaired maneuvering around the poles. The results are interpreted in terms of the competition for visual resources between the HUD and the world view. Author

A90-26278#
EFFECT OF EMERGENT DETAIL ON DESCENT-RATE ESTIMATIONS IN FLIGHT SIMULATORS

KIMBERLY A. REARDON (Systems Research Laboratories, Inc., Dayton, OH) and RIK WARREN (USAF, Armstrong Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 2. Columbus, OH, Ohio State University, 1989, p. 714-719. refs

In an effort to conserve computer resources and imitate the resolving power of the human eye, high fidelity simulators use a hierarchy of detail. The resulting displays consist of detail that emerges onto the display as altitude is lost, and fades from the display as altitude is gained. The purpose of this experiment was to determine the effect of emergent detail on descent-rate estimations. Results are consistent with previous findings that the emergence of detail neither hinders nor helps performance. Furtermore, there was no difference between displays that emerged in contrast, contrast and density, or contrast, density, and structure. Author

A90-26283#
AN EMPIRICAL INVESTIGATION OF THE EFFECT OF VIRTUAL COLLIMATED DISPLAYS ON VISUAL PERFORMANCE
JOHN A. WISE (Embry Riddle Aeronautical University, Daytona Beach, FL) and GARY W. SHERWIN (Westinghouse Research and Development Center, Pittsburgh, PA) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 2. Columbus, OH, Ohio State University, 1989, p. 743-748. refs

Recently questions have been raised about the accepted wisdom that collimated virtual displays assist pilots to focus their eyes at infinity in environments that tend to induce the eye to resting accommodation. This study evaluated whether the presence of collimated virtual imagery had an effect on a visual discrimination task presented at optical infinity. The study used a performance-based metric and a within subject experimental design. The study collected over 11,000 observations, and the results indicated that collimated virtual displays did not effect binocular visual discrimination performance of targets with good contrast. Author

A90-26296#
W/INDEX - A CREW WORKLOAD PREDICTION TOOL
VICTOR A. RILEY (Honeywell Systems and Research Center, Minneapolis, MN) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 2. Columbus, OH, Ohio State University, 1989, p. 832-837.

This paper describes the Workload Index (W/INDEX), a software tool for predicting the operator work load produced by specific crew-station designs over the course of representative mission scenarios. The W/INDEX allows system designers to consider the work-load consequences of decisions involving the physical layout of the crew station, the application of automation to specific crew tasks, and the use of various human-machine interface technologies and crew-task loading sequences. Result of a cognitive work study are presented. I.S.

A90-26297#
HUMAN PERFORMANCE/SYSTEMS SAFETY ISSUES IN AIRCRAFT ACCIDENT INVESTIGATION AND PREVENTION
ALAN E. DIEHL (USAF, Inspection and Safety Center, Norton AFB, CA) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 2. Columbus, OH, Ohio State University, 1989, p. 838-847. refs

This paper examines the human-performance/systems safety issues in aircraft accident investigation. Attention is given to the hazard/incident/accident relationship in the accident-generation event, the elements of the investigation process, and the types of prevention measures which can be employed to ultimately decrease the probability of similar mishaps. Special consideration is given to the interface between human factors (which are associated with 50 to 90 percent of all accidents), and safety concepts. Examples of successful accident-prevention programs are presented, demonstrating that combining human-performance information with well-known system-safety methods can drastically decrease the probability of mishaps. I.S.

A90-26303#
DEFINING MAN-MACHINE INTERFACE REQUIREMENTS FOR AIR TRAFFIC CONTROL STATIC INFORMATION DISPLAYS
HOWARD S. BASHINSKI, DAVID C. DUNKLE, and DAVID R. LENOROVITZ (CTA, Inc., Englewood, CO) IN: International Symposium on Aviation Psychology, 5th, Columbus, OH, Apr. 17-20, 1989, Proceedings. Volume 2. Columbus, OH, Ohio State University, 1989, p. 878-883.

This paper discusses static information sources used in the Advanced Automation System for air traffic control and explores ways of displaying and accessing this information. Forty-six possible sources of static information, presented in tabular form, were analyzed for their valuability and rated as either 'critically important', 'valuable', 'marginally valuable', or 'delete' (and retained only in current hardcopy form). The analysis included visits to several ATC facilities for observing what static-information products were being utilized, where they were stored, and how they were being accessed. I.S.

A90-26850
MEASUREMENT OF MAXIMUM ARREST FORCE IN PERFORMANCE TESTS OF FALL PROTECTION EQUIPMENT
ANDREW C. SULOWSKY (Ontario-Hydro, Research Div., Toronto, Canada) and JAMES W. BRINKLEY (USAF, Armstrong Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH) Journal of Testing and Evaluation (ISSN 0090-3973), vol. 18, March 1990, p. 123-127. refs
Copyright

Frequency response characteristics for electronic measurement systems and mechanical test fixtures used in tests of fall protection equipment are proposed. The recommendations are based upon the analysis of the dynamic properties of the human body as measured in impact and vibration tests with volunteer subjects. The critical frequencies that are associated with human injury were found to be in the range of 0 to 16 Hz. A corner frequency of 100 Hz is recommended for the measurement system, and a minimum resonant frequency of 200 Hz is recommended for the mechanical test fixture. Author

A90-27402* Jet Propulsion Lab., California Inst. of Tech., Pasadena.
HUMAN LIFE SUPPORT DURING INTERPLANETARY TRAVEL AND DOMICILE. I - SYSTEM APPROACH
P. K. SESHAN, JOSEPH FERRALL, and NARESH ROHATGI (JPL, Pasadena, CA) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 9 p.
(SAE PAPER 891431) Copyright

The importance of mission-driven system definition and assessment for extraterrestrial human life support is examined. The tricotyledon theory for system engineering is applied to the physiochemical life support system of the Pathfinder project. The rationale and methodology for adopting the systems approach is discussed. The assessment of the system during technology development is considered. I.F.

A90-27411
THERMAL MANAGEMENT AND ENVIRONMENTAL CONTROL OF HYPERSONIC VEHICLES
SRIDHAR K. IYA, ARUN K. TRIKHA, and MICHAEL M. LADD (Boeing Advanced Systems, Seattle, WA) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 11 p.
(SAE PAPER 891440) Copyright

Hypervelocity endo/exoatmospheric vehicles experience extremely severe thermal conditions, requiring an integrated vehicle-wide approach to thermal management. The paper presents a discussion of key thermal management and environmental control issues with examples from two classes of vehicles, namely a Mach 6 interceptor aircraft and a single-stage-to-orbit vehicle. The

elements of a general thermal management optimization methodology are discussed. Trade study results between a single-phase and a two-phase cooling loop used on the single-stage-to-orbit vehicle are also presented. Author

A90-27413* Umpqua Research Co., Myrtle Creek, Ore.
APPLICATION OF BIOCATALYSTS TO SPACE STATION ECLSS AND PMMS WATER RECLAMATION
CLIFFORD D. JOLLY (UMPQUA Research Co., Myrtle Creek, OR) and ROBERT M. BAGDIGIAN (NASA, Marshall Space Flight Center, Huntsville, AL) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 7 p. refs
(Contract NAS8-37642)
(SAE PAPER 891442) Copyright

Immobilized enzyme reactors have been developed and tested for potential water reclamation applications in the Space Station Freedom Environmental Control and Life Support System (ECLSS) and Process Materials Management System (PMMS). The reactors convert low molecular weight organic contaminants found in ECLSS and PMMS wastewaters to compounds that are more efficiently removed by existing technologies. Demonstration of the technology was successfully achieved with two model reactors. A packed bed reactor containing immobilized urease was found to catalyze the complete decomposition of urea to by-products that were subsequently removed using conventional ion exchange results. A second reactor containing immobilized alcohol oxidase showed promising results relative to its ability to convert methanol and ethanol to the corresponding aldehydes for subsequent removal. Preliminary assessments of the application of biocatalysts to ECLSS and PMMS water reclamation sytems are presented. Author

A90-27414* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
TEST RESULTS ON REUSE OF RECLAIMED SHOWER WATER - A SUMMARY
CHARLES E. VEROSTKO, RAFAEL GARCIA, RICHARD SAUER (NASA, Johnson Space Center, Houston, TX), RICHARD P. REYSA (Boeing Aerospace and Electronics, Houston, TX), ARTHUR T. LINTON (Hamilton Standard Management Services, Inc., Houston, TX) et al. SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 17 p.
(SAE PAPER 891443) Copyright

Results are presented from tests to evaluate a microgravity whole body shower and waste water recovery system design for possible use on the Space Station. Several water recovery methods were tested, including phase change distillation, a thermoelectric hollow fiber membrane evaporation subsystem, and a reverse osmosis dynamic membrane system. Consideration is given to the test hardware, the types of soaps evaluated, the human response to showering with reclaimed water, chemical treatment for microbial control, the procedures for providing hygienic water, and the quality of water produced by the systems. All three of the waste water recovery systems tested successfully produced reclaimed water for reuse. R.B.

A90-27415
WATER RECOVERY BY VAPOR COMPRESSION DISTILLATION
ROBERT N. SCHMIDT (Life Systems, Inc., Cleveland, OH) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 12 p. refs
(SAE PAPER 891444) Copyright

The use of vapor compression distillation (VCD) as the water recovery procedure for the Space Station is examined. This method is proposed for the Ultrapure Water System of the Space Station. The VCD procedure is described. The applicability of the VCD is evaluated and compared with a thermoelectrically integrated membrane evaporation subsystem. The data reveal that the VCD provides better quality product water, higher water recovery rates, higher capacity, and is cost effective. I.F.

A90-27416* Umpqua Research Co., Myrtle Creek, Ore.
RECOVERY OF HYGIENE WATER BY MULTIFILTRATION
DAVID F. PUTNAM, CLIFFORD D. JOLLY, GERALD V. COLOMBO (UMPQUA Research Co., Myrtle Creek, OR), and DON PRICE (NASA, Johnson Space Center, Houston, TX) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 12 p.
(Contract NAS9-17523)
(SAE PAPER 891445) Copyright

A multifiltration hygiene water reclamation process that utilizes adsorption and particulate filtration techniques is described and evaluated. The applicability of the process is tested using a simulation of a 4-man subsystem operation for 240 days. It is proposed the process has a 10 year life, weighs 236 kg, and uses 88 kg of expendable filters and adsorption beds to process 8424 kg of water. The data reveal that the multifiltration is an efficient nonphase change technique for hygiene water recovery and that the chemical and microbiological purity of the product water is within the standards specified for the Space Station hygiene water. I.F.

A90-27417* Bend Research, Inc., OR.
A NOVEL MEMBRANE-BASED WATER-RECLAMATION POSTTREATMENT UNIT
JANE KUCERA GLENGER, RODERICK J. RAY, SCOTT B. MCCRAY (Bend Research, Inc., OR), and DAVID PUTNAM (UMPQUA Research Co., Myrtle Creek, OR) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 13 p. refs
(Contract NAS9-17611)
(SAE PAPER 891446) Copyright

This paper describes the development of an advanced membrane/sorption-bed hybrid subsystem to posttreat humidity condensate and phase-change distillate generated during space missions. Discussed are the design and construction of a breadboard hybrid subsystem, and data showing the performance of this subsystem operating for more than 90 days. The purpose of this program was to reduce the number of sorption beds required by this subsystem by using membranes to concentrate the contaminants. Tests show that the breadboard hybrid subsystem presented here uses 50 percent fewer sorption beds than a stand-alone multifiltration process. Author

A90-27418
LEAK DETECTION FOR SPACE STATION FREEDOM FLUID LINES
ROBERT H. HERTEL and RICHARD A. HEPPNER (Perkin-Elmer Corp., Applied Science Div., Pomona, CA) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 8 p.
(SAE PAPER 891448) Copyright

This paper describes a preliminary design concept developed for an ionization gauge to detect leaks in external fluid-carrying lines of Space Station Freedom. Special attention is given to the leak detection requirements of the gauge, the leak detection instrumentation, and the leak-detector operating modes. The pressure sensor proposed for leak sensing is a modified Bayard-Alpert ionization gauge. The design modifications introduced involve the filament, the gauge size, and gauge sensitivity. The redesigned gauge requires less than 5 W of power, weighs less than 4 lb, and was shown to meet the performance requirements. I.S.

A90-27419
SPACE STATION FREEDOM CARBON DIOXIDE REMOVAL ASSEMBLY
ROBERT KAY and LORI WOODWARD (Allied-Signal Aerospace Co., Torrance, CA) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 8 p.
(SAE PAPER 891449) Copyright

Carbon dioxide removal from the Space Station Freedom atmosphere is an essential part of the overall life support and oxygen reclamation process. The system must selectively remove carbon dioxide from an air supply stream, then concentrate it for

downstream processing in a carbon dioxide reduction system where oxygen is eventually recovered. Space Station Freedom will utilize a four-bed molecular sieve system for the carbon dioxide removal assembly. This system uses the principle of adsorption to selectively remove and concentrate carbon dioxide. The technology required for the four-bed system is well established and was proven in space flight during the Skylab program. This paper describes the four-bed molecular sieve carbon dioxide removal system, its operation, and its key components. Author

A90-27420
PRELIMINARY EVALUATION OF A MEMBRANE GAS SEPARATION UNIT FOR SPACE STATION FREEDOM ATMOSPHERE REVITALIZATION SUBSYSTEM
RONALD J. KUSE (Boeing Aerospace and Electronics, Huntsville, AL) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 19 p. refs
(SAE PAPER 891450) Copyright

A study was initiated to investigate the potential of integrating a membrane gas separation unit into the Space Station Atmosphere Revitalization Subsystem to remove inert impurities in the carbon dioxide stream fed to the Bosch reduction reactor. Removal of the inerts eliminates the need for a reactor bleed stream and subsequent treatment. Preliminary calculations indicate that under normal operating conditions, inclusion of the membrane unit reduces Atmosphere Revitalization power consumption and heat rejection by 388 and 300 watts, respectively, and causes only small weight and space penalties to be incurred. According to current cost factors, an annual net savings of $0.76 million (in 1989 dollars) excluding separator hardware costs is realized. Although based on preliminary data and estimates, there appears to be reasons for cautious optimism in the proposed design modification and continuation of the study to obtain more detailed data. Author

A90-27421
ATMOSPHERIC COMPOSITION MONITOR ASSEMBLY FOR SPACE STATION FREEDOM ENVIRONMENTAL CONTROL AND LIFE SUPPORT SYSTEM
MARY A. ROTHERAM (Perkin-Elmer Corp., Applied Science Div., Pomona, CA) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 9 p.
(SAE PAPER 891451) Copyright

The Atmospheric Composition Monitor Assembly (ACMA) is an instrument for monitoring the composition of the atmosphere in Space Station Freedom. The ACMA is composed of the following major instruments: Major Constituent Analyzer (MCA); Carbon Monoxide Monitor (COM); Trace Contaminant Monitor (TCM); and Particle Counter Monitor (PCM). the MCA is a mass spectrometer based system that provides continuous monitoring of major atmospheric constituents (O2, CO2, N2, H2O) and of hydrogen and ethane. The COM is a nondispersive infrared instrument for the continuous monitoring of trace levels of carbon monoxide. The TCM is a gas chromatograph-mass spectrometer for monitoring trace levels of contaminants. The PCM monitors the concentration of particulates in the 0.5 to 100 micron range using a light scattering technique. Author

A90-27423*
VACUUM RESOURCE PROVISION FOR SPACE STATION FREEDOM
KENNETH J. LASKEY, THEODORE G. MORDFIN, and THOMAS W. RUSS (Grumman Corp., Reston, VA) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 17 p. refs
(Contract NASW-4300)
(SAE PAPER 891453) Copyright

The use of vacuum resources is integral to a number of proposed concepts for gas disposal from Space Staton Freedom. These include both direct overboard venting and onboard collection and storage of waste gases. A methodology is presented for determining flowrates through proposed vacuum lines. The flowrates through overboard vents are used to calculate number column densities, which are compared with current Freedom program requirements. The results are combined with discussions about the relative merits of some proposed and alternate concepts for providing vacuum resources. Author

A90-27427
SPACE STATION FREEDOM ACTIVE INTERNAL THERMAL CONTROL SYSTEM - A DESCRIPTIVE OVERVIEW
R. A. HEISING and J. E. HORNER (Allied-Signal Aerospace Co., AiResearch Los Angeles Div., CA) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 14 p.
(SAE PAPER 891458) Copyright

The active internal thermal control system (ITCS) for Space Station Freedom will consist of multiple closed-cycle heat transport water loops that acquire, transport, and reject heat to the exterior central thermal bus. Heat loads to be cooled by the ITCS include the environmental control and life support systems (ECLSS), avionics racks, and user experiments (located in the laboratory module). The ITCS is an advanced single-phase pumped water loop that incorporates on-orbit repair features and enhanced components, such as high-efficiency, long-life centrifugal pumps and digital valves that allow step-wise precision control of valve position for modulating the water flow rate. Commonality is emphasized throughout the ITCS, and was a design driver during the selection of the ITCS components. Cold plate and heat exchanger designs are standardized to accommodate a variety of users. This paper describes the overall system, the subsystems, and the components within the ITCS from an operational viewpoint. Author

A90-27428
AVIONICS AIR COOLING FOR SPACE STATION FREEDOM
ROSS CUSHMAN (United Technologies Corp., Hamilton Standard Div., Windsor Locks, CT) and HARLAN BURKE (Boeing Aerospace and Electronics, Huntsville, AL) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 11 p.
(SAE PAPER 891459) Copyright

The paper provides a comparison of two possible approaches to avionics air cooling for Space Station modules, using requirements and ground rules established during Space Station definition studies. The first approach is the 'centralized' approach, which uses a large central fan and heat exchanger which maintains a supply of cooled air to module racks, via a network of interconnected ducting and flow isolation valves. The second approach is the 'distributed'approach, which uses individual fan/heat exchanger packages for each rack. Detailed tests and analyses are presented for both concepts. Both are indicated to have unique attributes and limitations while imposing different burdens on the vehicle systems. It is concluded that both approaches can be designed to satisfy Space Station avionics heat removal requirements. R.E.P.

A90-27429
A PRELIMINARY HEAT FLOW ANALYSIS OF THE U.S. LABORATORY AND HABITATION MODULES
W. D. BEVERLY, R. E. DANDRIDGE, and R. D. PRODEN (Boeing Aerospace and Electronics, Huntsville, AL) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 12 p.
(SAE PAPER 891460) Copyright

The results of a preliminary evaluation of the heat loads for the Space Station Freedom U.S. Laboratory and Habitation modules are presented. The data for this analysis was based on a rack-by-rack assessment of preliminary module configurations. Data gathered included cooling requirements, temperature range, duty cycle and cooling split between liquid and air coolants for representative subsystem and experiment heat loads. A Monte Carlo analysis of the heat load data was performed. The analysis results allowed initial sizing of the module cabin air, avionics air, and liquid cooling systems. The analysis allowed assessment of the effects of additional experiment automation as well as the

effects of decreased avionics air cooling capacity. Although the heat load data and module configuration are preliminary in nature and will undergo significant revision as the Space Station Freedom design progresses, the results of this analysis provide a first look at the module energy flow. Author

A90-27440* Grumman Aerospace Corp., Bethpage, NY.
A HUMAN FACTORS EVALUATION OF EXTRAVEHICULAR ACTIVITY GLOVES
JOHN M. O'HARA, MICHAEL BRIGANTI (Grumman Space Systems, Bethpage, NY), JOHN CLELAND, and DAN WINFIELD (Research Triangle Institute, Research Triangle Park, NC) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 14 p.
(Contract NAS9-17702)
(SAE PAPER 891472) Copyright

One of the major problems faced in Extravehicular Activity (EVA) glove development has been the absence of concise and reliable methods to measure the effects of EVA gloves on human-hand capabilities. NASA has sponsored a program to develop a standardized set of tests designed to assess EVA-gloved hand capabilities in six performance domains: Range of Motion, Strength, Tactile Perception, Dexterity, Fatigue, and Comfort. Based upon an assessment of general human-hand functioning and EVA task requirements, several tests within each performance domain were developed to provide a comprehensive evaluation. All tests were designed to be conducted in a glove box with the bare hand, an EVA glove without pressure, an EVA glove at operation pressure. Thus, the differential effect on performance of the glove with and without pressure was tested. Bare hand performance was used to 'calibrate' the effects. Ten subjects participated in the test setup as a repeated-measures experimental design. The paper will report the results of the test program. Author

A90-27444
OUTFITTING OF THE CREW HEALTH CARE SYSTEM FOR THE SPACE STATION FREEDOM
JOHN J. NAGEL, RICHARD A. SMITH, MICHAEL F. STOLLE, and JOHN B. TROWBRIDGE (McDonnell Douglas Space Systems Co., Houston, TX) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 15 p.
(SAE PAPER 891476) Copyright

Crew medical care will be one of the most essential provisions of the Space Station of the 1990s. Increased duration in space, reduced crew selectivity, and reduced return to earth capability all speak strongly for a complete set of medical instrumentation and supplies, countermeasures for space adaptation syndrome, and the capability to closely monitor the total environment in which the crew live and work. Foreseeing these needs, NASA has committed to the development of a Crew Health Care Element for Space Station Freedom. It consists of three systems: Health Maintenance Facility, Exercise Countermeasures Facility, and Environmental Health System. For the majority of the equipment to outfit these systems, space flight ready instruments do not exist. Therefore, commercial off the shelf items will have to be converted to flight certification levels and some will even have to be modified to accommodate the microgravity conditions of Space Station Freedom. Still other capabilities will have to be developed from the ground up. The development of the CHeC element will provide many challenges to the project engineers and scientists. Author

A90-27445* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
DEVELOPMENT OF THE CELSS EMULATOR AT NASA JSC
HATICE S. CULLINGFORD (NASA, Johnson Space Center, Houston, TX) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 9 p.
(Contract NAS9-17900)
(SAE PAPER 891477) Copyright

The Controlled Ecological Life Support System (CELSS) Emulator is under development at the NASA Johnson Space Center (JSC) with the purpose to investigate computer simulations of integrated CELSS operations involving humans, plants, and process machinery. This paper describes Version 1.0 of the CELSS Emulator that was initiated in 1988 on the JSC Multi Purpose Applications Console Test Bed as the simulation framework. The run module of the simulation system now contains a CELSS model called BLSS. The CELSS Emulator makes it possible to generate model data sets, store libraries of results for further analysis, and also display plots of model variables as a function of time. The progress of the project is presented with sample test runs and simulation display pages. Author

A90-27446
PERFORMANCE SIMULATION OF ENVIRONMENTAL CONTROL SYSTEMS WITH INTERFACE ORIENTED MODELLING TECHNIQUE
MARKUS ROTHMEYER and RALF SIMON (Dornier GmbH, Friedrichshafen, Federal Republic of Germany) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 14 p. refs
(SAE PAPER 891478) Copyright

The use of an interface oriented modeling technique for the assembly, subsystem, and system simulation of the Enviromental Control and Life Support System (ECLSS) is examined. The modular nature of the basic concept and the use of several numerical solution techniques are discussed. As an example, the simulation of a simplified ECLS subsystem, the related input data, and the computed results are presented. Areas of further developments aimed at the creation of a knowledge based simulation tool are outlined. V.L.

A90-27447
ON THE REPRESENTATION OF LIFE-SUPPORT SYSTEM MODELS
HEINZ A. PREISIG, TAE YEONG LEE, FRANK LITTLE, and BRUCE WRIGHT (Texas A & M University, College Station) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 15 p. refs
(SAE PAPER 891479) Copyright

A canonical decomposition of models describing physical-chemical-biological systems is described which is based on Newtonian physics and axiomatic thermodynamics. The resulting hierarchical representation of complex models prepares for an object oriented modeling support tool which will readily interface to knowledge-based tools. It also approaches the documentation problem for large systems and has the structure that allows multiple user interfaces to be implemented each of which is specific for a certain group of researchers in the interdisciplinary team. Author

A90-27448* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
DAWN (DESIGN ASSISTANT WORKSTATION) FOR ADVANCED PHYSICAL-CHEMICAL LIFE SUPPORT SYSTEMS
MARY R. RUDOKAS, ELIZABETH R. CANTWELL (NASA, Ames Research Center, Moffett Field, CA), PETER I. ROBINSON, and TIMOTHY W. SHENK (RECOM Software, Inc., Moffett Field, CA) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 12 p. refs
(SAE PAPER 891481) Copyright

This paper reports the results of a project supported by the National Aeronautics and Space Administration, Office of Aeronautics and Space Technology (NASA-OAST) under the Advanced Life Support Development Program. It is an initial attempt to integrate artificial intelligence techniques (via expert systems) with conventional quantitative modeling tools for advanced physical-chemical life support systems. The addition of artificial intelligence techniques will assist the designer in the definition and simulation of loosely/well-defined life support processes/problems as well as assist in the capture of design knowledge, both quantitative and qualitative. Expert system and conventional modeling tools are integrated to provide a design workstation that assists the engineer/scientist in creating, evaluating, documenting and optimizing physical-chemical life

support systems for short-term and extended duration missions. Author

A90-27449
THE IMPACT OF THE WATER RECOVERY AND MANAGEMENT (WRM) SUBSYSTEM WASTEWATER RECOVERY EFFICIENCY UPON THE SPACE STATION FREEDOM ECLSS WATER BALANCE
JAMES ROCKTOFF (Grumman Corp., Space Station Program Support Div., Reston, VA) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 23 p. refs
(SAE PAPER 891482) Copyright

A parametric study of the impact of the ECLSS water recovery subsystem wastewater processing efficiency upon the overall Space Station Freedom water balance was performed. A representative range of recovery efficiencies was used for each of the three different water recovery processes. The recovery efficiency associated with the hygiene wastewater reclamation process proved to be particularly significant in determining the overall Space Station Freedom ECLSS water balance because of the relatively large volume of fluid treated within this loop. The analysis also indicated that a positive ECLSS water balance depended upon the ability to double process the concentrated brine discharged from the reverse osmosis waste-hygiene-water processor. Implications of the WRM subsystem sensitivity analysis results for the Space Station Freedom ECLSS as well as the effects upon the propulsion and fluid management systems are discussed. R.E.P.

A90-27450* McDonnell-Douglas Space Systems Co., Huntsville, AL.
MICROGRAVITY SENSITIVITIES FOR SPACE STATION ECLS SUBSYSTEMS
M. E. BANGHAM, T. W. CARROLL (McDonnell Douglas Space Systems Co., Huntsville, AL), and W. R. HUMPHRIES (NASA, Marshall Space Flight Center, Huntsville, AL) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 9 p.
(SAE PAPER 891483) Copyright

This report presents a review of the Space Station Environmental Control and Life Support subsystems (ECLSS) for sensitivity to low gravity environments. The object of this review is to categorize sensitivity areas and to quantify the risks. This review addresses all processes from a top level view and then examines in more detail those areas which were considered potential risks. The study has concentrated on the primary function of the subsystems which may be significant to the performance of the particular component and does not address integration of the subsystem and/or the mechanical aspects of the designs. The areas of primary concern were the Atmosphere Revitalization (AR), Water Recovery and Management (WRM), and the Waste Management (WM) subsystems. Author

A90-27451
FEASIBILITY OF A COMMON ELECTROLYZER FOR SPACE STATION FREEDOM
DONALD H. SARGENT (Grumman Corp., Space Station Program Support Div., Reston, VA) and GEORGE R. SCHMIDT (Booz-Allen and Hamilton, Inc., Bethesda, MD) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 8 p. refs
(SAE PAPER 891484) Copyright

The Baseline Space Station Freedom architecture calls for separate and independent water electrolysis subsystems in ECLSS and in Propulsion. A study to assess the potential benefits and impacts of electrolyzer commonality evaluated fifteen sets of ECLSS and Propulsion architectural options with graduated levels of commonality, first by quantifying the electrical power, weight, volume, and heat rejection requirements; and then qualitatively according to safety and redundancy, reliability and maintainability, integration and verification, and assembly. There were no compelling quantitative or qualitative advantages of the options incorporating commonality which would drive a decision to alter the Baseline. The options were also compared with respect to estimated program costs. The maximum projected savings were less than five per cent, likely within the uncertainty of the estimation process. The overall conclusion reached was that the Baseline, of independent unit design and subsystem architectures, should be retained. Author

A90-27452* Texas A&M Univ., College Station.
COMPARISON OF WASTE COMBUSTION AND WASTE ELECTROLYSIS - A SYSTEMS ANALYSIS
MARK T. HOLTZAPPLE and FRANK E. LITTLE (Texas A & M University, College Station) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 36 p. refs
(Contract NAG9-253)
(SAE PAPER 891485) Copyright

A steady state model of a closed environmental system has been developed which includes higher plant growth for food production, and is designed to allow wastes to be combusted or electrolyzed. The stoichiometric equations have been developed to evaluate various trash compositions, food items (both stored and produced), metabolic rates, and crew sizes. The advantages of waste electrolysis versus combustion are: (1) oxygen is not required (which reduces the load on the oxygen producing system); (2) the CO2 and H2 products are produced in pure form (reducing the load on the separators); and (3) nitrogen is converted to nitrate (which is directly usable by plants). Weight tradeoff studies performed using this model have shown that waste electrolysis reduces the life support weight of a 4-person crew by 1000 to 2000 kg. R.E.P.

A90-27467* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
SYSTEM LEVEL DESIGN ANALYSES FOR THE SPACE STATION ENVIRONMENTAL CONTROL AND LIFE SUPPORT SYSTEM
A. S. BACSKAY and J. C. KNOX (NASA, Marshall Space Flight Center, Huntsville, AL) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 19 p. refs
(SAE PAPER 891500) Copyright

The development and verification of a computer model for the design and analysis of the current Space Station ECLSS configuration are discussed. The model is used to resolve system-level design issues, such as sizing accumulators and assessing flow control techniques. Actual component verification efforts are outlined, and technical aspects of each component model are identified. The results obtained to date and plans for future analytical efforts are summarized. V.L.

A90-27469* McDonnell-Douglas Space Systems Co., Houston, TX.
MASS ANALYSIS FOR THE SPACE STATION ECLSS USING THE BALANCE SPREADSHEET METHOD
WEN-HO CHU (McDonnell Douglas Space Systems Co., Houston, TX) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 14 p. Research supported by NASA. refs
(SAE PAPER 891502) Copyright

The balance spreadsheet method is applied to mass analysis of the Environmental Control and Life Support System (ECLSS). The spreadsheet layout reduces the complexity of the ECLSS analysis by concisely defining the sources, sinks, and net changes in mass for each fluid. The analysis method is illustrated by using information from the latest Space Station ECLSS Architectural Control Documents and a given Space Station assembly sequence. The analysis results are plotted and discussed. Author

A90-27470
ARTIFICIAL INTELLIGENCE APPLICATION TO ADVANCED ECLS SYSTEMS
BENJAMIN E. BISHOP, JR. and ALBERT M. BOEHM (United

Technologies Corp., Hamilton Standard Div., Windsor Locks, CT) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 11 p. refs
(SAE PAPER 891503) Copyright

The role of advanced automation and artificial intelligence in facilitating ECLSS control and diagnostics is reviewed with reference to the preliminary design of the Space Station. In particular, the possible role of advanced computer capabilities in advanced missions, such as the growth station and moon and Mars exploration, is examined. The benefits of artificial intelligence are discussed from both the expert system and learned system perspectives. V.L.

A90-27471
APPLICATION OF BIOREGENERATIVE SUBSYSTEMS TO AN ENVIRONMENTAL CONTROL AND LIFE SUPPORT SYSTEM FOR A MANNED MARS SPRINT MISSION
S. R. GUSTAVINO and M. M. MANKAMYER (McDonnell Douglas Space Systems Co., Space Station Div., Houston, TX) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 13 p. refs
(SAE PAPER 891504) Copyright

This paper describes the application of bioregenerative subsystems to an environmental control and life support system (ECLSS) for long-duration manned Mars missions. Special attention is given to the integration of new bioregenerative subsystems into a computer model of an ECLSS for such a mission. The model is being developed using both the existing physicochemical computer simulations and new bioregenerative component simulations, along with a plant growth unit (PGU) which simulates the growth cycle for white potatoes. The ECLSS configuration and the PGU structure are discussed, and diagrams of both are presented. I.S.

A90-27472* Boeing Aerospace Co., Seattle, WA.
LIFE SUPPORT SYSTEM DEFINITION STUDY FOR LONG DURATION PLANETARY MISSIONS
T. SLAVIN, P. MEYER (Boeing Aerospace and Electronics, Seattle, WA), and R. REYSA (Boeing Aerospace and Electronics, Houston, TX) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 14 p.
(Contract NAS9-18040)
(SAE PAPER 891505) Copyright

The development of a mission planners life support systems (LSS) guidebook for providing data on the impact of various LSS on mission parameters such as mass, power, and volume is discussed. The factors utilized to define LSS case study mission drivers, and driver and mission impact parameter definitions are described. An example of a guidebook table for a specific set of LSS drivers is provided. Four approaches for physical/chemical closed-loop LSS are examined. A preliminary LSS guidebook for a lunar base is presented. I.F.

A90-27473* Westinghouse Research and Development Center, Pittsburgh, PA.
CARBON DIOXIDE AND WATER VAPOR HIGH TEMPERATURE ELECTROLYSIS
ARNOLD O. ISENBERG (Westinghouse Research and Development Center, Pittsburgh, PA) and CHARLES E. VEROSTKO (NASA, Johnson Space Center, Houston, TX) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 18 p.
(Contract NAS9-17590)
(SAE PAPER 891506) Copyright

The design, fabrication, breadboard testing, and the data base obtained for solid oxide electrolysis systems that have applications for planetary manned missions and habitats are reviewed. The breadboard tested contains sixteen tubular cells in a closely packed bundle for the electrolysis of carbon dioxide and water vapor. The discussion covers energy requirements, volume, weight, and operational characteristics related to the measurement of the reactant and product gas compositions, temperature distribution along the electrolyzer tubular cells and through the bundle, and thermal energy losses. The reliability of individual cell performance in the bundle configuration is assessed. V.L.

A90-27474* Bend Research, Inc., OR.
INVESTIGATION OF HUMIDITY CONTROL VIA MEMBRANE SEPARATION FOR ADVANCED EXTRAVEHICULAR MOBILITY UNIT (EMU) APPLICATION
D. D. NEWBOLD, R. J. RAY, W. A. PLEDGER, S. B. MCCRAY (Bend Research, Inc., OR), and M. F. BROWN (NASA, Johnson Space Center, Houston, TX) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 10 p. refs
(Contract NAS9-17983)
(SAE PAPER 891507) Copyright

This paper describes the development of a membrane-based process for dehumidifying the Extravehicular Mobility Unit (EMU). The membrane process promises to be smaller, lighter, and more energy efficient than the other technologies for dehumidification. The dehydration membranes were tested for 90 days at conditions expected to be present in the EMU. The results of these tests indicate that membrane-based technology can effectively control humidity in the EMU. Author

A90-27475* Photo Catalytics, Inc., Boulder, CO.
PHOTOCATALYTIC POST-TREATMENT IN WASTE WATER RECLAMATION SYSTEMS
GERALD COOPER, MATTHEW A. RATCLIFF (Photo-Catalytics, Inc., Boulder, CO), and CHARLES E. VEROSTKO (NASA, Johnson Space Center, Houston, TX) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 12 p. refs
(Contract NAS9-17983)
(SAE PAPER 891508) Copyright

A photocatalytic water purification process is described which effectively oxidizes organic impurities common to reclaimed waste waters and humidity condensates to carbon dioxide at ambient temperatures. With this process, total organic carbon concentrations below 500 ppb are readily achieved. The temperature dependence of the process is well described by the Arrhenius equation and an activation energy barrier of 3.5 Kcal/mole. The posttreatment approach for waste water reclamation described here shows potential for integration with closed-loop life support systems. V.L.

A90-27476* Texas A&M Univ., College Station.
PERFORMANCE CHARACTERIZATION OF WATER RECOVERY AND WATER QUALITY FROM CHEMICAL/ORGANIC WASTE PRODUCTS
W. M. MOSES, T. D. ROGERS, H. CHOWDHURY (Texas A & M University, College Station), and H. S. CULLINGFORD (NASA, Johnson Space Center, Houston, TX) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 10 p. refs
(Contract NAG9-251; NAG9-253)
(SAE PAPER 891509) Copyright

The water reclamation subsystems currently being evaluated for the Space Shuttle Freedom are briefly reviewed with emphasis on a waste water management system capable of processing wastes containing high concentrations of organic/inorganic materials. The process combines low temperature/pressure to vaporize water with high temperature catalytic oxidation to decompose volatile organics. The reclaimed water is of potable quality and has high potential for maintenance under sterile conditions. Results from preliminary experiments and modifications in process and equipment required to control reliability and repeatability of system operation are presented. V.L.

A90-27477* Texas A&M Univ., College Station.
ELECTROCHEMICAL INCINERATION OF WASTES
L. KABA, G. D. HITCHENS, and J. O'M. BOCKRIS (Texas A & M University, College Station) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989.

17 p. refs
(Contract NAG9-192)
(SAE PAPER 891510) Copyright

A low temperature electrolysis process has been developed for the treatment of solid waste material and urine. Experiments are described in which organic materials are oxidized directly at the surface of an electrode. Also, hypochlorite is generated electrochemically from chloride component of urine. Hypochlorite can act as a strong oxidizing agent in solution. The oxidation takes place at 30-60 C and the gaseous products from the anodic reaction are carbon dioxide, nitrogen, oxygen. Hydrogen is formed at the cathode. Carbon monoxide, and nitrogen oxides and methane were not detected in the off gases. Chlorine was evolved at the anode in relatively low amounts. Author

A90-27479
SPACE STATION FREEDOM GASEOUS TRACE CONTAMINANT LOAD MODEL DEVELOPMENT
MARK I. LEBAN and PHILLIP A. WAGNER (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 13 p. refs
(SAE PAPER 891513) Copyright

A Space Station Freedom gaseous contaminant load model has been developed. It consists of 214 contaminants with their Spacecraft Maximum Allowable Concentrations, and their estimated generation rates. The Space Station Freedom load model is based on load models developed for previous space missions. It should be considered a preliminary, not a final load model, as it is continually being expanded and updated as new data on Space Station Freedom becomes available. Author

A90-27480* Houston Univ., Clear Lake, TX.
A RATIONALE FOR ATMOSPHERIC MONITORING ON SPACE STATION FREEDOM
DENNIS M. CASSERLY (Houston, University, Clear Lake, TX) and DANE M. RUSSO (NASA, Johnson Space Center, Houston, TX) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 8 p. refs
(SAE PAPER 891514) Copyright

The atmosphere monitoring needs for the Space Station Freedom are identified by examining the monitoring requirements for supplied breathing air in confined spaces, as in the case of submarines and the Shuttle. Some other factors influencing the monitoring requirements for Space Station Freedom are also identified. These include: the experience of past missions and ground based tests; the proposed experimental and manufacturing processes and their hazards; and limitations of the life support systems. V.L.

A90-27481
BIOISOLATION TESTING OF SPACE STATION FREEDOM MODULAR HABITATS
PAUL WARD-DOLKAS and TERI SCHNEPP (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 8 p.
(SAE PAPER 891516) Copyright

Previous testing verified that bioisolation between animal specimens and a spacecraft crew can be provided at the level of the individual specimen's living quarters (modular habitat) by the use of microbial air filters. As a follow-on effort, a long term experiment was performed to (1) determine the effective lifetime of the microbial filters and (2) collect and analyze condensate from the heat exchanger. This paper presents results showing that the filters provided effective microbial isolation throughout the 58 day tests. Condensate data analysis is also presented. The experiment was repeated for a two week period without filters to serve as a control. Author

A90-27494* National Aeronautics and Space Administration, Washington, DC.
CREW SYSTEM DYNAMICS - COMBINING HUMANS AND AUTOMATION
MARY CONNORS (NASA, Washington, DC) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 10 p. refs
(SAE PAPER 891530) Copyright

Some of the human factor issues involved in effectively combining human and automated systems are examined with particular reference to spaceflights. The concepts of the crew system and crew systems dynamics are defined, and the present status of crew systems is summarized. The possibilities and potential problems aasociated with the use of automated systems are discussed, as are unique capabilities and possible errors introduced by human participants. It is emphasized that the true integration of human and automated systems must allow for the characteristics of both. V.L.

A90-27495
DESIGN OF THE ENVIRONMENTAL CONTROL AND LIFE SUPPORT SYSTEMS FOR THE COLUMBUS PRESSURIZED MODULES
K.-O. HIENERWADEL and G. KRING (Dornier GmbH, Friedrichshafen, Federal Republic of Germany) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 13 p.
(SAE PAPER 891531) Copyright

For the long duration mission intended for the Columbus pressurized modules as used in former applications like Spacelab had to be advanced. The development encompasses modifications of assemblies/functions which have been part of existing systems as well as the implementation of new features like the trace gas contamination monitoring assembly. All functions which form a part of one of the two ECLSSs are listed and described with their status at the beginning of Phase C/D. Special emphasis is given to the air loops. Author

A90-27497
DEVELOPMENT OF THE CATALYTIC OXIDIZER TECHNOLOGY FOR THE EUROPEAN SPACE PROGRAMME
KLAUS AMMANN (Draegerwerk AG, Luebeck, Federal Republic of Germany) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 10 p.
(SAE PAPER 891533) Copyright

The development of a technological breadboard for a catalytic oxidizer assembly is described. The assembly was designed to remove the light-weight hydrocarbons, H, and CO from a Space Station atmosphere. With regard to the necessary flow rate, CO turned out to be the design driver while methane governed the thermal design. A concept was selected consisting of a high flow/low temperature catalyst for CO oxidation and a low flow/high temperature catalyst for the removal of the more stable contaminants. Test results on both assembly and ECLSS-subsystem level, including experiments with selected catalyst poisons, are presented. Author

A90-27498
MICROBIOLOGICAL CONTAMINATION CONTROL IN THE COLUMBUS PROJECT
JACQUELINE BAUNE and MANFRED BAUNE (MBB-ERNO, Bremen, Federal Republic of Germany) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 6 p.
(SAE PAPER 891534) Copyright

Microbiological contamination is likely to be a problem on long duration space missions. Therefore a study was performed to establish preliminary requirements and control plan. The major findings are that manned pressurized modules should be delivered into orbit virtually free of microbes, be designed to inhibit microbial growth and be easy to clean. Author

A90-27499
BAF - AN ADVANCED ECOLOGICAL CONCEPT FOR AIR QUALITY CONTROL
ROGER A. BINOT (ESTEC, Noordwijk, Netherlands) and P. G. PAUL (Comprimo, Netherlands) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 10 p. refs
(SAE PAPER 891535) Copyright

A preliminary study has been initiated to evaluate the feasibility of a self-regenerating biological air filter (BAF) onboard future inhabited space stations to alleviate the disdvantages and limitations of the physicochemical systems. The discussion focuses on the biodegradability of the various contaminants that are likely to be found in spacecraft and their production rates and allowed concentrations versus the kinetic and equilibrium constants for their degradation that are needed for the sizing of the system. V.L.

A90-27501
AIR LOOP CONCEPTS FOR ENVIRONMENTAL CONTROL AND LIFE SUPPORT
H. P. LEISEIFER, B. PATTI (ESTEC, Noordwijk, Netherlands), and K. O. HIENERWADEL (Dornier System GmbH, Friedrichshafen, Federal Republic of Germany) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 14 p. refs
(SAE PAPER 891537) Copyright

The relation between air loops and the ECLSS of manned spacecraft is studied. Air loop functions in laboratory modules and design implementation for various conceptual approaches are discussed. Particular consideration is given to centralized and decentralized ECLSS; separated and combined air loops; free and nonfree subfloor architecture; cabin loop ventilation; and rack cooling. The use of air loops in the Columbus project is examined. I.F.

A90-27502* Krug International, Houston, TX.
AN OVERVIEW OF THE SPACE STATION FREEDOM ENVIRONMENTAL HEALTH SYSTEM
ELIZABETH E. RICHARD (Krug International Corp., Houston, TX) and DANE RUSSO (NASA, Johnson Space Center, Houston, TX) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 6 p. refs
(SAE PAPER 891538) Copyright

The proposed environmental health system (EHS) designed for the closed environment of the Space Station is examined. The internal contamination control and environmental health considerations for the Space Station are discussed. The microbiology, toxicology, water quality, radiological health, vibroacoustics, and barothermal physiology subsystems of the EHS are described. Proposed capabilities of the EHS are: the environmental sample collection, processing, and analysis of the breathing atmosphere, potable and hygiene water, and internal surfaces. I.F.

A90-27503* Alabama Univ., Huntsville.
PROBLEMS IN WATER RECYCLING FOR SPACE STATION FREEDOM AND LONG DURATION LIFE SUPPORT
D. S. JANIK, W. J. CRUMP (Alabama, University, Huntsville), B. A. MACLER, T. WYDEVEN, JR. (NASA, Ames Research Center, Moffett Field, CA), and R. L. SAUER (NASA, Johnson Space Center, Houston, TX) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 9 p. refs
(SAE PAPER 891539) Copyright

A biologically-enhanced, physical/chemical terminal water treatment testbed for the Space Station Freedom is proposed. Recycled water requirements for human, animal, plant and/or combined crews for long duration space missions are discussed. An effective terminal treatment method for recycled water reclamation systems that is based on using granular activated carbon as the principal active agent and the controls of microbial contamination and growth within recycled water systems are examined. The roles of plants in water recycling within CELSS is studied. I.F.

A90-27504* Krug International, Houston, TX.
MICROBIAL IDENTIFICATION SYSTEM FOR SPACE STATION FREEDOM
HARLAN D. BROWN, JANIE B. SCARLETT, JOYCE A. SKWERES (Krug International Corp., Houston, TX), RUSSELL L. FORTUNE, JOHN L. STAPLES (Vitek Systems, Inc., Hazelwood, MO), and DUANE L. PIERSON (NASA, Johnson Space Center, Houston, TX) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 8 p. refs
(SAE PAPER 891540) Copyright

The Environmental Health System (EHS) and Health Maintenance Facility (HMF) on Space Station Freedom will require a comprehensive microbiology capability. This requirement entails the development of an automated system to perform microbial identifications on isolates from a variety of environmental and clinical sources and, when required, to perform antimicrobial sensitivity testing. The unit currently undergoing development and testing is the Automated Microbiology System II (AMS II) built by Vitek Systems, Inc. The AMS II has successfully completed 12 months of laboratory testing and evaluation for compatibility with microgravity operation. The AMS II is a promising technology for use on Space Station Freedom. Author

A90-27505* Alabama Univ., Huntsville.
DEFINITION OF A NEAR REAL-TIME MICROBIOLOGICAL MONITOR FOR APPLICATION IN SPACE VEHICLES
MELVIN V. KILGORE, JR., ROBERT J. ZAHORCHAK, WILLIAM F. ARENDALE (Alabama, University, Huntsville), SAMUEL S. WOODWARD (Boeing Aerospace and Electronics, Seattle, WA), and DUANE L. PIERSON (Boeing Co., Biomedical Laboratories; NASA, Johnson Space Center, Houston, TX) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 9 p. refs
(SAE PAPER 891541) Copyright

The concepts and methodologies for microbiological monitoring in space are examined, focusing on the determination of the requirements of a near real-time microbiological monitor. Results are presented from the technical evaluation of five microbiological monitor concepts, including cultural methods, single cell detection, biomolecular detection, specific product detection, and general molecular composition. Within these concepts, twenty-eight specific methodolgies were assessed and the five candidate methodplogies with the highest engineering and feasibility scores were selected for further evaluations. The candidate methodologies are laser light scattering, primary fluorescence, secondary fluorescence, volatile product detection, and electronic particle detection. The advantages and disadvantages of these five candidate methodologies are discussed. R.B.

A90-27507* Krug International, Houston, TX.
BIOFILM FORMATION AND CONTROL IN A SIMULATED SPACECRAFT WATER SYSTEM - INTERIM RESULTS
JOHN R. SCHULTZ, ROBERT D. TAYLOR, DAVID T. FLANAGAN, RANDALL E. GIBBONS, HARLAN D. BROWN (Krug International Corp., Houston, TX), RICHARD L. SAUER (NASA, Johnson Space Center, Houston, TX) et al. SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 12 p. refs
(SAE PAPER 891543) Copyright

The ability of iodine to control microbial contamination and biofilm formation in spacecraft water distribution systems is studied using two stainless steel water subsystems. One subsystem has an iodine level of 2.5 mg/L maintained by an iodinated ion-exchange resin. The other subsystem has no iodine added. Stainless steel coupons are removed from each system to monitor biofilm formation. Results from the first six months of operation indicate that 2.5 mg/L of iodine has limited the number of viable bacteria that can be recovered from the iodinated subsystem. Epifluorescence microscopy of the coupons taken from this

subsystem, however, indicates some evidence of microbial colonization after 15 weeks of operation. Numerous bacteria have been continually removed from both the water samples and the coupons taken from the noniodinated subsystem after only 3 weeks of operation. Author

A90-27508
DEVELOPMENT ACTIVITIES FOR THE EUROPEAN EVA SPACE SUIT SYSTEM (ESSS)
NIKOLAUS HERBER (Dornier GmbH, Friedrichshafen, Federal Republic of Germany) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 18 p.
(SAE PAPER 891544) Copyright

A development status evaluation is presented for the ESA EVA Space Suit System (ESSS) being designed for Hermes spacecraft servicing of the Columbus Free Flying Laboratory in LEO. An 'EVA Suit Enclosure Module' (ESEM) has been defined which, as the anthropomorphic, pressure-retentive enclosure of the crewmember, must facilitate the operationally required mobility and dexterity. An EVA Life Support Module attached to the ESEM provides respiration gases, metabolic cooling, nutrition, and waste collection, while the EVA Information and Communication Module provides control and data-processing functions. EVA Support and Verification Equipment is also incorporated by the ESSS system. O.C.

A90-27510
THE DEVELOPMENT STATUS OF THE HERMES ENVIRONMENTAL CONTROL AND LIFE SUPPORT SUBSYSTEM
R. SCHAFER (Dornier GmbH, Friedrichshafen, Federal Republic of Germany) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 8 p. refs
(SAE PAPER 891547) Copyright

The development and subsystems of the Hermes ECLSS are described. The components and functions of the atmosphere pressure control section are discussed. Consideration is given to the functions of the air conditioning section, the liquid management section, and the food/galley management section. The composition and operation of the human and solid waste management section and the monitoring, control and power management section are examined. Configurations of the ECLSS for various phases of the development are provided. I.F.

A90-27511
CO2 PROCESSING AND O2 RECLAMATION SYSTEM SELECTION PROCESS FOR FUTURE EUROPEAN SPACE PROGRAMMES
M. ARLOW and G. TRAXLER (Oesterreichische Raumfahrt- und Systemtechnik Gesellschaft mbH, Vienna, Austria) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 14 p. Research supported by ESTEC.
(SAE PAPER 891548) Copyright

The process used to select the regenerative CO2 processing and O2 reclamation system for the AOC phase of the Columbus program is discussed. The system requirements are outlined, including the metabolic gas exchange ratio and specified cabin leakage rates. Candidate system configurations are described and compared in terms of interface, technology availability, water quantity and quality requirements and oxygen, carbon, and hydrogen loop closure considerations. The process of preselecting eight candidate system configurations from sixty-four candidates and the final selection of the final baseline configuration are discussed. R.B.

A90-27512
LIFE SUPPORT - FUTURE TRENDS AND DEVELOPMENTS
ROBIN C. HUTTENBACH and JAMES D. H. RADFORD (Nelson Space Services, Ltd., London, England) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 18 p. refs
(SAE PAPER 891549) Copyright

Design trends in life support systems currently under consideration for prospective manned space missions are discussed, with a view to the development status of the regenerative, 'closed-loop' systems required for permanent microgravity orbit stations, long-duration transports, and ultimately even lunar and planetary bases. While such regenerative systems will in the medium term employ physicochemical methods in such tasks as the recovery of oxygen from exhaled CO2, and resort of open-loop methods in the matters of food supply and waste disposal, there will eventually be a resort to a combination of biological and physicochemical processes to recycle organic nutrients and grow food. O.C.

A90-27513
WASTE MANAGEMENT ABOARD MANNED SPACECRAFT
CHRISTOPHER A. LAMBE, DENISE L. OAKLEY, ALAN ROSEVEAR (Atomic Energy Research Establishment, Harwell Laboratory, England), CLAUDE CHIPAUX (Matra, S.A., Velizy-Villacoublay, France), and ROGER A. BINOT (ESTEC, Noordwijk, Netherlands) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 9 p.
(SAE PAPER 891550) Copyright

The reasons for dealing with waste, the main treatment options, and the available technologies are discussed. Recommendations are then proposed about those technologies which will need to be developed. Waste management aims to make a change of form which is both advantageous in terms of volume and hazard reduction and which does not compromise crew health and safety. A broad overview of the waste management strategies required to treat wastes from missions of increasing length is presented. In conclusion, the basic philosophy behind any successful waste management strategy will involve the exclusion of microbial activity and, thus, waste stabilization, and/or the inclusion of microbial degradation processes for the treatment of biodegradable wastes leading to element recycle within a closed environmental life support system. R.E.P.

A90-27514
VAPOR COMPRESSION DISTILLATION SUBSYSTEM EVALUATION - MICROBIOLOGICAL ANALYSIS OF SYSTEM HARDWARE, PRETREATMENT SOLUTIONS AND PRODUCT WATER
JOSEPH L. ZELIBOR, TIMOTHY L. HUFF, MELVIN V. KILGORE, JR. (Alabama, University, Huntsville), MARY S. TRAWEEK, GERALD A. WHITMAN (Boeing Aerospace and Electronics, Seattle, WA) et al. SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 11 p. refs
(SAE PAPER 891551) Copyright

A Space Station Freedom life-support system candidate component, the urine water-recovery function Vapor Compression Distillation Subsystem (VCDS), has undergone testing; its hardware, urine pretreatment solution, brine-solution, and product tank water have all been sampled for microbiological analysis. The largest bacterial populations were collected from product tank water. It is judged that bacteria, especially those producing either spores or extracellular polymeric substances, are able to survive pretreatment and VCDS operation, rendering product water unacceptable. O.C.

A90-27515* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
CMIF ECLS SYSTEM TEST FINDINGS
RICHARD G. SCHUNK, ROBYN L. CARRASQUILLO, KATHYRN Y. OGLE, PAUL O. WIELAND, and ROBERT M. BAGDIGIAN (NASA, Marshall Space Flight Center, Huntsville, AL) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 13 p.
(SAE PAPER 891552) Copyright

During 1987 three Space Station integrated Environmental Control and Life Support System (ECLSS) tests were conducted at the Marshall Space Flight Center (MSFC) Core Module Integration Facility (CMIF) as part of the MSFC ECLSS Phase II

test program. The three tests ranged in duration from 50 to 150 hours and were conducted inside of the CMIF module simulator. The Phase II partial integrated system test configuration consisted of four regenerative air revitalization subsystems and one regenerative water reclamation subsystem. This paper contains a discussion of results and lessons learned from the Phase II test program. The design of the Phase II test configuration and improvements made throughout the program are detailed. Future plans for the MSFC CMIF test program are provided, including an overview of planned improvements for the Phase III program.
Author

A90-27516* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
PHASE III INTEGRATED WATER RECOVERY TESTING AT MSFC - DESIGN, PLANS, AND PROTOCOLS
ROBERT M. BAGDIGIAN (NASA, Marshall Space Flight Center, Huntsville, AL) and GERALD A. WHITMAN (Boeing Aerospace Co., Seattle, WA) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 13 p. refs
(SAE PAPER 891554) Copyright

A series of tests is being conducted at the NASA Marshall Space Flight Center (MSFC) to evaluate the performance of a closed-loop water recovery system. Testing will be conducted at various levels of integration and loop-closure, culminating in complete closure of the water system with man-in-the-loop. This paper summarizes the test goals and objectives as well as the system design, plans, and protocols which have been established.
Author

A90-27517* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
SPACE STATION ENVIRONMENTAL CONTROL AND LIFE SUPPORT SYSTEM TEST FACILITY AT MARSHALL SPACE FLIGHT CENTER
DARLENE SPRINGER (NASA, Marshall Space Flight Center, Huntsville, AL) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 7 p.
(SAE PAPER 891555) Copyright

Different aspects of Space Station Environmental Control and Life Support System (ECLSS) testing are currently taking place at Marshall Space Flight Center (MSFC). Unique to this testing is the variety of test areas and the fact that all are located in one building. The north high bay of building 4755, the Core Module Integration Facility (CMIF), contains the following test areas: the Subsystem Test Area, the Comparative Test Area, the Process Material Management System (PMMS), the Core Module Simulator (CMS), the End-use Equipment Facility (EEF), and the Pre-development Operational System Test (POST) Area. This paper addresses the facility that supports these test areas and briefly describes the testing in each area. Future plans for the building and Space Station module configurations will also be discussed.
Author

A90-27518
SPACE STATION PHASE III ENVIRONMENTAL CONTROL AND LIFE SUPPORT SYSTEM, TEST BED CONTROL AND DATA ACQUISITION SYSTEM DESIGN
JAMES B. SCHULTZ and BOB M. THORNTON (Micro Craft, Inc., Huntsville, AL) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 8 p.
(SAE PAPER 891556) Copyright

The design of a data acquisition and control system for the ECLSS testbed for the Space Station is examined. The phase III ECLSS is classified into air revitalizaiton systems and water reclamation and management systems. The system utilizes programmable logic controllers and personal communications software. The electrical hardware, logic controllers, and computer software needed to acquire the data and provide control system functions are described. Hardware/software interfacing techniques and methods for implementing both automatic and manual control using ladder logic and programmable logic controllers are discussed. Various system diagrams are provided. I.F.

A90-27530* California Univ., Los Angeles.
CRITERIA FOR EVALUATING EXPERIMENTS ON CROP PRODUCTION IN SPACE
W. L. BERRY (California, University, Los Angeles), H. KOONTZ (Connecticut, University, Storrs), R. WHEELER (Bionetics Corp., Cocoa Beach, FL), and R. PRINCE (NASA, Kennedy Space Center, Cocoa Beach, FL) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 7 p. refs
(SAE PAPER 891569) Copyright

Consideration is given to the development of criteria for successful CELSS experiments on crop production in space. Also, the development of a standard procedure to produce a given expected yield is examined. Factors influencing the success of CELSS experiments are discussed, including environmental limits to growth, efficient use of resources, data collection sensitivity, stress, and the space in which the experiment is performed. The implications of the study for designing CELSS food production systems are noted. R.B.

A90-27531
A MODELING SYSTEM FOR CONTROL OF THE THERMAL AND FLUID DYNAMICS OF THE NASA CELSS CROP GROWTH RESEARCH CHAMBER
ANN L. BLACKWELL and C. C. BLACKWELL (Texas, University, Arlington) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 19 p. refs
(SAE PAPER 891570) Copyright

Consideration is given to the modeling system used to develop a means of controlling the thermal and fluid dynamics of the NASA CELSS Crop Growth Research Center (CGRC). The tolerance requirements for atmospheric variables in the CGRC are given. The system developed to control the environment conditions in the CGRC plant growth chamber is described. The modeling procedure used to develop the atmospheric control system for the CGRC is examined in detail. The approach used to derive the equations that describe the dynamic behavior of the plant growth chamber and the linkage between the model of the physical system commponents and the model of the biological component are discussed. R.B.

A90-27534
CELSS ENGINEERING - PROPORTIONAL CONTROL OF CO2 USING HIGHER PLANTS
BRUCE D. WRIGHT and ALBERT GARCIA, III (Texas A & M University, College Station) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 10 p. refs
(SAE PAPER 891573) Copyright

Higher plants have physiological responses to the environment which can be utilized in a Controlled Ecological Life Support System to increase system reliability and to simplify design. The rate of CO2 uptake by the plants will affect the CO2 concentration in the CELSS and vice versa. This response of photosynthesis to CO2 concentration can be used as a proportional controller for atmospheric CO2 in the CELSS. Results from growth chamber experiments with wheat confirm this possibility. Times series analysis techniques are presented which provide a quantitative measure of this proportional control. System reliability is increased when biological and mechanical systems are used in parallel.
Author

A90-27535
PRELIMINARY DESIGN OF JEM ENVIRONMENTAL CONTROL AND LIFE SUPPORT SYSTEM
K. SHIRAKI, H. HASHIMOTO, K. MANABE (NASDA, Tokyo, Japan), A. HATTORI, and H. HAMA (Kawasaki Heavy Industries, Ltd., Kobe, Japan) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 10 p. refs
(SAE PAPER 891574) Copyright

This paper outlines the current status of the preliminary design study of the JEM ECLSS, one of the subsystems in JEM which is attached to the Space Station core. ECLSS functions, the design concepts for ECLSS function allocation between FEM and the

Space Station core, and JEM ECLSS function/hardware distribution are established. The design approach emphasizes the JEM emergency system concept with respect to contamination control and monitoring and to fire detection and suppression, which must be standardized throughout all modules in Space Station. Author

A90-27536
STUDY OF ADVANCED SYSTEM FOR AIR REVITALIZATION
H. ISHIDA, H. YAMASHIRO, S. FUJITA, K. MASUYAMA, S. KONDO (Kawasaki Heavy Industries, Ltd., Kobe, Japan) et al. SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 14 p. refs
(SAE PAPER 891575) Copyright

A feasibility study of the Space Station Air Revitalization System (ARS) is presented. Tests of the CO2 Removal/Concentration Subsystem (CRC), the O2 Generation Subsystem (OGS), and the Trace Contaminant Control Subsystem (TCCS) are discussed. The components of an advanced ARS are described. C.D.

A90-27537
STUDY OF AIR REVITALIZATION SYSTEM FOR SPACE STATION
M. MINEMOTO, T. ETOH, H. IDA, S. HATANO, N. KAMISHIMA (Mitsubishi Heavy Industries, Ltd., Kobe, Japan) et al. SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 14 p. refs
(SAE PAPER 891576) Copyright

The results are reported of various test and simulation calculations performed on a system to remove from the air the CO2 produced by human metabolisms in closed environments such as space stations, and to regenerate O2 from the CO2. Design data are presented on an adsorption/desorption system using solid amine for removing and concentrating CO2 and on a Bosch reaction system for obtaining solid carbon and water by reducing concentrated CO2. Optimum conditions for operating the device are described. C.D.

A90-27538
APPLICABILITY OF MEMBRANE DISTILLATION METHOD TO SPACE EXPERIMENTAL WASTE WATER TREATMENT
HIROSHI OKAZAKI, HIROYO MATSUMOTO, AKIRA KAKIMOTO, and HIROAKI MATSUMOTO (Mitsubishi Heavy Industries, Ltd., Kobe, Japan) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 9 p. refs
(SAE PAPER 891578) Copyright

Consideration is given to the possible use of membrane distillation combined with conventional water treatment processes for water reclamation for the Space Station. Emphasis is given to a study of the water reclamation system designed for the Life Science Experiment for the JEM. The evacuating method for membrane distillation is tested using a spiral wound element-type module and a hollow-fiber element-type module. Results are presented from evaluations of the water quality of products obtained from the treatment of an algae culture solution and rat urine. R.B.

A90-27539* Lockheed Engineering and Sciences Co., Houston, TX.
DEVELOPMENT OF A PREPROTOTYPE ADVANCED EXTRAVEHICULAR MOBILITY UNIT (AEMU) REGENERABLE LIFE SUPPORT SUBSYSTEM - A PROGRESS REPORT
NORMAN C. ALLEN (Lockheed Engineering and Sciences Co., Houston, TX) and B. MICHAEL LAWSON (NASA, Johnson Space Center, Houston, TX) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 20 p.
(SAE PAPER 891579) Copyright

Regenerable life support (RLS) technologies are being developed for use in the Advanced Extravehicle Mobility Unit (AEMU) aboard Space Station Freedom. This report describes the requirements that these RLS technologies must satisfy in the Space Station application and the significant features of the technologies now being evaluated. Who is developing the equipment and how the subsystems will be integrated are addressed. An overview of the planned test program schedule is given. C.D.

A90-27540
ADVANCED PORTABLE LIFE SUPPORT SYSTEM COMPONENT INTEGRATION AND SYSTEM TESTING
WESLEY COLEMAN and DAN REYNOLDS (Rockwell International Corp., El Segundo, CA) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 19 p.
(SAE PAPER 891580) Copyright

A facility has been designed and built to perform the first integrated testing of Space Station Freedom Extravehicular Mobility Unit Portable Life Support System. The test articles are a non-venting thermal sink, a metal oxide CO2 absorber, a quaternary amine CO2 absorber, and a fast response CO2 sensor. The water loop and vent loop of the EMU are simulated using facility fluid movers. Minimum volume and thermal mass were also drivers. Difficulties in system design and the resolution of each are discussed. Author

A90-27541
THERMAL SINK FOR THE ADVANCED EXTRAVEHICULAR MOBILITY UNIT PORTABLE LIFE SUPPORT SYSTEM
HAL J. STRUMPF (Allied-Signal Aerospace Co., AiResearch Los Angeles Div., Torrance, CA) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 10 p. refs
(SAE PAPER 891581) Copyright

A study is being conducted to design, develop, fabricate, integrate, and test a preprototype coolant loop subsystem for an advanced extravehicular mobility unit portable life support system for Space Station Freedom. The overall function of the coolant loop is to remove metabolic and equipment heat loads and provide a comfortable thermal environment for a crewperson during extravehicular activity. The heat loads are transported by water circulating through a liquid-cooled ventilation garment. The thermal environment is regulated using thermal capacitive and/or radiative control. After use, the system must be capable of regenerating relatively rapidly. The key component in the coolant loop is the thermal sink, which is a completely nonventing unit comprising cold-plate heat exchangers, a radiator to reject a fraction of the generated heat load, and a regenerable thermal storage unit to absorb the remaining heat load. No embedded thermoelectric devices are required. Author

A90-27543* United Technologies Corp., Windsor Locks, CT.
A HELMET MOUNTED DISPLAY DEMONSTRATION UNIT FOR A SPACE STATION APPLICATION
CAROLYN G. GERNUX, ROBERT W. BLASER (United Technologies Corp., Hamilton Standard Div., Windsor Locks, CT), and JOSE MARMOLEJO (NASA, Johnson Space Center, Houston, TX) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 8 p.
(Contract NAS9-17543)
(SAE PAPER 891583) Copyright

Under NASA guidance an advanced development helmet mounted display (HMD) has been designed and fabricated. Delivery has been made of an extravehicular mobility unit (EMU) HMD demonstration unit as an alternative to the current low-resolution, chest-mounted display, and cuff-mounted checklists. Important design goals achieved with this HMD include the use of transmissive liquid display image sources with fairly high resolution (text, graphics, and video compatible), binocular viewing with total image overlap, virtual image projection, low profile packaging, low power design, and demonstration of voice control of the HMD data. Test results showed that the HMD program successfully demonstrated the feasibility of the concept and operated as designed, meeting the necessary program requirements. R.E.P.

A90-27544* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
A TELESCIENCE MONITORING AND CONTROL CONCEPT FOR A CELSS PLANT GROWTH CHAMBER
DARYL N. RASMUSSEN and ARSHAD MIAN (NASA, Ames Research Center; General Electric Co., Moffett Field, CA) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 12 p. refs
(SAE PAPER 891585) Copyright

Consideration is given to the use of telescience to monitor and control a Space Station CELSS plant growth chamber (PGC). The proposed telescience control system contains controllers for PGC subsystems, a local master controller, and remote controllers. The benefits of telescience are discussed and the functional requirements of the PGC are outlined. A typical monitoring and control scenario is described. It is suggested that the proposed concept would provide remote access to a ground-based CELSS research facility, Space Station plant growth facilities, lunar-based CELSS facilities, and manned interplanetary spacecraft. R.B.

A90-27545* Lockheed Missiles and Space Co., Sunnyvale, CA.
CONCEPTUAL DESIGN OF A CLOSED LOOP NUTRIENT SOLUTION DELIVERY SYSTEM FOR CELSS IMPLEMENTATION IN A MICRO-GRAVITY ENVIRONMENT
STEVEN H. SCHWARTZKOPF (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA), MEL W. OLESON (Boeing Aerospace Co., Seattle, WA), and HATICE S. CULLINGFORD (NASA, Johnson Space Center, Houston, TX) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 10 p. refs
(Contract NAS9-17981)
(SAE PAPER 891586) Copyright

This paper describes the results of a study to develop a conceptual design for an experimental, closed-loop fluid handling system capable of monitoring, controlling, and supplying nutrient solution to higher plants. The Plant Feeder Experiment (PFX) is designed to be flight tested in a micro-gravity (micro-g) environment and was developed under NASA's In-Space Technology Experiments Program (INSTEP). When flown, PFX will provide information on both the generic problems of micro-g fluid handling and the specific problems associated with the delivery of nutrient solution in a micro-g environment. The experimental hardware is designed to fit into two middeck lockers on the Space Shuttle, and incorporates several components that have previously been flight tested. Author

A90-27546* Life Systems, Inc., Cleveland, OH.
ATMOSPHERE CONTROL FOR PLANT GROWTH FLIGHT EXPERIMENTS
FEROLYN T. POWELL, MARTIN SUDAR (Life Systems, Inc., Cleveland, OH), MARC TIMM, and BRUCE YOST (Bionetics Corp., Cocoa Beach, FL) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 11 p. Research sponsored by NASA, Bionetics Corp., and Life Systems, Inc.
(SAE PAPER 891587) Copyright

An atmosphere exchange system (AES) has been designed to provide a conditioned atmosphere supply to plant specimens in flight without incurring the large weight and volume associated with bottled gases. The paper examines the atmosphere filter cartridge (AFC) designed to remove trace organic atmosphere contaminants from the Space Shuttle cabin and to condition the cabin atmosphere prior to exposure to plant specimens. The AES and AFC are described and illustrated. The AFC design requirements are discussed and results are presented from tests on the performance of the AFC. Also, consideration is given to the potential applications of the AFC and future design concepts for atmosphere control. R.B.

A90-27548
CONCEPTUAL DESIGN OF AN AMMONIA SYNTHESIZER FOR SPACE APPLICATIONS
MARK HOLTZAPPLE (Texas A & M University, College Station) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 13 p. refs
(SAE PAPER 891589) Copyright

A space-based ammonia synthesizer fixes nitrogen for plants or algae grown in a closed environmental life support system. The reactor in this conceptual design operates at 4000 atm to achieve nearly complete conversion of nitrogen and hydrogen to ammonia. This high pressure is developed by a four-stage compressor which is a modified version of a proven laboratory design. This ammonia synthesis system (including the equipment to separate nitrogen from the air) is estimated to have the following specifications for a four-person crew: weight = 57 kg, power = 710 W, volume = 125 l. Author

A90-27550* Barrios Technology, Inc., Houston, TX.
PERFORMANCE EVALUATION OF ADVANCED SPACE SUIT CONCEPTS FOR SPACE STATION
DAVID M. KLAUS (Barrios Technology, Inc., Houston, TX) and PHILIP R. WEST (NASA, Johnson Space Center, Houston, TX) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 14 p. refs
(SAE PAPER 891591) Copyright

The requirements for an advanced space suit for Space Station EVA and the methods used to evaluate candidate suit concepts are examined. Two candidate Space Station suits, the AX-5 and the Mk. III, are described and illustrated. The methods to test these suits are discussed, including, tests at the NASA/Johnson Space Center Weightless Environment Training Facility, tests in the microgravity environment of the KC-135 aircraft, CO2 washout evaluations, component torque measurements, environmental hazards protection evaluations, and component cycle life verification. R.B.

A90-27551* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
RESULTS AND APPLICATIONS OF A SPACE SUIT RANGE-OF-MOTION STUDY
AL REINHARDT (NASA, Ames Research Center, Moffett Field, CA) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 15 p. Previously announced in STAR as N89-26398. refs
(SAE PAPER 891592) Copyright

The range of motion of space suits has traditionally been described using limited 2-D mapping of limb, torso, or arm movements performed in front of an orthogonal grid. A new technique for recovering extra-vehicular (EVA) space suit range-of-motion data during underwater testing was described in a paper presented by the author at the 1988 conference. The new technique uses digitized data which is automatically acquired from video images of the subject. Three-dimensional trajectories are recovered from these data, and can be displayed using 2-D computer graphics. Results of using this technique for the current shuttle EVA suit during underwater simulated weightlessness testing are discussed. Application of the data for use in animating anthropometric computer models is highlighted. Author

A90-27554* Allied-Signal Aerospace Co., Torrance, CA.
METAL OXIDE REGENERABLE CARBON DIOXIDE REMOVAL SYSTEM FOR AN ADVANCED PORTABLE LIFE SUPPORT SYSTEM
MAURENA S. NACHEFF (Allied-Signal Aerospace Co., AiResearch Los Angeles Div., Torrance, CA), CRAIG H. CHANG (Allied-Signal Engineered Materials Research Center, Des Plaines, IL), GERALD V. COLOMBO (Umpqua Research Co., Myrtle Creek, OR), and ROBERT J. CUSICK (NASA, Johnson Space Center, Houston, TX) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 14 p. refs
(Contract NAS9-17836)
(SAE PAPER 891595) Copyright

The development of a CO2 removal system for an astronaut portable life support system to meet the EVA requirements for the Space Station is discussed, focusing on the factors important in the selection of the metal oxide absorbent for CO2 removal.

Results from laboratory tests on metal oxide absorbent materials are given, including characterization studies and dynamic CO2 uptake and regeneration measurements. The preliminary design of the breadboard system to perform both the absorption and regeneration functions is presented. R.B.

A90-27557
BIOSPHERE II - TECHNICAL OVERVIEW OF A MANNED CLOSED ECOLOGICAL SYSTEM
WILLIAM F. DEMPSTER (Space Biospheres Venture, Oracle, AZ) SAE, Intersociety Conference on Environmental Systems, 19th, San Diego, CA, July 24-26, 1989. 7 p. refs
(SAE PAPER 891599) Copyright

The engineering aspects of the Biosphere II program are summarized. The Biosphere II is a closed ecological system under construction in Arizona. The temperature and humidity control, water cycling, energy, and data collection and control systems for the Biosphere II project are considered. The variable volume chambers used to expand and contract the atmosphere volume within the Biosphere II are described. The methods for creating waves, tides, and currents for the biosphere ocean and marsh system are outlined. The energy supply for the project and redundancies in the Biosphere II energy system are examined. Also, the potential applications for biospheric systems and possible spinoff biotechnologies from the Biosphere II program are discussed. R.B.

N90-17307# Texas A&M Univ., College Station. Dept. of Industrial Engineering.
INVESTIGATION OF THE EFFECTS OF EXTERNAL SUPPORTS ON MANUAL LIFTING Ph.D. Thesis
ALFRED ALAN AMENDOLA May 1989 126 p Sponsored by National Inst. for Occupational Safety and Health, Cincinnati, OH
(PB90-103367) Avail: NTIS HC A07/MF A01 CSCL 05/8

The study was conducted to assess the utility of the use of external support devices for manual lifting. Two commercially available devices, an airbelt and a compvest, and a combination of the two devices were tested in a lifting experiment for three frequencies of lift (three, six, and nine lifts per minute) using 20 male university student volunteers. The lifts were also performed with no device. The subjects lifted a tote box containing steel and lead shot from the floor to Metacarpal-3 height at various rates of lift and with different support devices for two 20 minute sessions. Four independent methods were used in the evaluation: biomechanical, psychophysical, subjective survey, and body part discomfort. No device was significantly different from the control condition for the maximum acceptable weight of lift over all the participants. No significant differences were noted in the compressive force in the low back among the device treatments. No preference was determined subjectively for any specific device. No significant differences were noted based on body part discomfort measurements. It was concluded from the study that the use of lifting devices is questionable as an aid in lifting. GRA

N90-17308*# Southern California Inst. of Architecture, Santa Monica.
SPACE STATION WARDROOM HABITABILITY AND EQUIPMENT STUDY
DAVID NIXON, CHRISTOPHER MILLER, and REGIS FAUQUET Washington NASA Dec. 1989 142 p
(Contract NCC2-356)
(NASA-CR-4246; NAS 1.26:4246) Avail: NTIS HC A07/MF A01 CSCL 06/11

Experimental designs in life-size mock-up form for the wardroom facility for the Space Station Habitability Module are explored and developed. In Phase 1, three preliminary concepts for the wardroom configuration are fabricated and evaluated. In Phase 2, the results of Phase 1 are combined with a specific range of program design requirements to provide the design criteria for the fabrication of an innovative medium-fidelity mock-up of a wardrobe configuration. The study also focuses on the design and preliminary prototyping of selected equipment items including crew exercise compartments, a meal/meeting table and a portable workstation. Design criteria and requirements are discussed and documented. Preliminary and final mock-ups and equipment prototypes are described and illustrated. Author

N90-17309# Illinois Univ. at Urbana-Champaign, Savoy. Aviation Research Lab.
PROXIMITY COMPATIBILITY AND INFORMATION DISPLAY: THE EFFECTS OF SPACE AND COLOR ON THE ANALYSIS OF AIRCRAFT STALL CONDITIONS Final Report
ANTHONY D. ANDRE and CHRISTOPHER D. WICKENS Oct. 1989 45 p
(Contract DAAA15-86-K-0013; DA PROJ. 1L1-61102-B-74-A)
(AD-A214488; HEL-TM-16-89) Avail: NTIS HC A03/MF A01 CSCL 23/2

The proximity compatibility principle (Wickens, 1987) asserts that when a task requires the integration of multiple sources of information, performance will be best supported when that information is displayed in close proximity. Conversely, when a task requires attention to be focused on a specific source of information, performance will be best supported by a more separated display. To assess the validity of this principle, a series of three experiments were conducted in which subjects monitored a display of flight parameters critical to aircraft stability and were required to either predict the likelihood of an aircraft stall (information integration) or to recall the value of a single flight parameter (focused attention). Display proximity of relevant information was imposed through spatial closeness and color similarity. The results indicate that color adheres to the proximity compatibility principle, but that space does not. Instead, the spatial proximity between relevant and irrelevant information appears to be the dominant factor affecting performance across both tasks. The data are discussed in terms of their practical implications for multi-element display design. GRA

N90-17310# School of Aerospace Medicine, Brooks AFB, TX.
PRESCRIBING SPECTACLES FOR AVIATORS Final Report, Sep. 1988 - Sep. 1989
ROBERT E. MILLER, II, JOHN F. KENT, and ROBERT P. GREEN, JR. Sep. 1989 36 p
(AD-A214830; USAFSAM-SR-89-5) Avail: NTIS HC A03/MF A01 CSCL 06/5

This special report was written as a review and reference for USAF vision specialists in prescribing spectacles for aviators. Vision correction in flyers presents unique problems especially for the presbyopes. The demands of each individual aircraft environment need to be well understood. USAF ophthalmologists and optometrists must consider the pertinent aeromedical factors before prescribing spectacles for ametropic aircrew members. This report includes a comprehensive guide to cockpit instrument panel distances and print sizes for most USAF aircraft. GRA

N90-17311# Air Force Medical Center, Wright-Patterson AFB, OH.
ATTENUATING THE LUMINOUS OUTPUT OF THE AN/PVS-5A NIGHT VISION GOGGLES AND ITS EFFECTS ON VISUAL ACUITY Final Report
RICHARD R. LEVINE and CHARENCE E. RASH Sep. 1989 36 p
(AD-A214895; USAARL-89-24) Avail: NTIS HC A03/MF A01 CSCL 20/6

Aviators in combat may be subjected to a variety of noxious light stimuli. Filters and other eye protective devices may be used to counter these threats. At night, filters may be used in conjunction with image intensification devices (e.g., night vision goggles) to provide useful low-light vision as well as protection from deleterious light sources (e.g., lasers, pyrotechnics, nuclear fireballs, etc.). Technologies may be combined in a single, integrated head gear unit. The present study was performed in order in consider the effects on visual acuity after reducing night vision goggle luminous output from 0 to 99 percent. A range of target contrasts and ambient illumination levels was investigated. AN/PVS-5A goggles were selected based upon their compatibility with current phosphor

display technology and their current ubiquity within aviation units. Visual acuity was assayed behaviorally because of its critical importance in flying performance. The results of the study provide normative acuity data with goggles alone and document the effects on goggle visual acuity with reduced goggle luminances as might be produced by protective materials placed between the goggles and the eyes. GRA

N90-17312# Aerospace Medical Research Labs., Wright-Patterson AFB, OH.
SUBJECTIVE WORKLOAD ASSESSMENT TECHNIQUE (SWAT): A USER'S GUIDE Interim Report, Jun. 1986 - Oct. 1988
SCOTT S. POTTER, JEINE R. BRESSLER (Systems Research Labs., Inc., Dayton, OH.), and GARY B. REID Jul. 1989 118 p
(Contract F33615-85-C-0541; AF PROJ. 7184)
(AD-A215405; AAMRL-TR-89-023) Avail: NTIS HC A06/MF A01 CSCL 05/8

This report serves as a user's guide to accompany software Version 3.1 for the Subjective Workload Assessment Technique (SWAT), a tool for measuring mental workload. The guide was developed as a how-to manual for implementing SWAT. A general overview of workload is presented, all aspects of the scale development phase are described in detail, general information relating to the event scoring phase and development phase is provided, information relating to the event scoring phase is provided, and finally, each menu and screen of the program is explained step by step. Various topics are covered including descriptions of the three SWAT dimensions, use of conjoint measurement and scaling, card sort procedures and analysis, methods of prototyping, event scoring, and data analysis. Each how-to section that the user will need is provided in an appendix so that the appropriate section can be separated from the rest of the report for handy reference. GRA

N90-17313# Army Research Inst. of Environmental Medicine, Natick, MA.
PHYSIOLOGICAL EVALUATION OF MEN WEARING THREE DIFFERENT TOXICOLOGICAL PROTECTIVE SYSTEMS
LESLIE LEVINE, BRUCE S. CADARETTE, MICHAEL N. SAWKA, and KENT B. PANDOLF Aug. 1989 12 p
(AD-A215527) Avail: NTIS HC A03/MF A01 CSCL 15/6

This study examined the physiological responses of seven volunteers exercising in the heat while wearing three different toxicological protective systems. The Toxicological Agent Protective (TAP) suit has been available for use for more than 30 years while the other two protective systems are developmental efforts. The Self-Contained Toxicological Environmental Protection Outfit (STEPO) includes either a backpack-rebreather (with CO2 scrubber) and ice-cooling vest (STEPO-R), or a tether system which supplies breathing/cooling air inside the suit (STEPO-T). After the volunteers were heat acclimated, the three toxicological protection systems were evaluated utilizing a counter-balanced experimental design initially in a hot and then in a cool environment while subjects walked at 1.12 m/s, 0 percent grade for an attempted two hours. There was no statistical advantage of any one system in terms of exercise time in the cool environment. While evaporated sweating rate was greater for the STEPO-T in the cool environment compared to both STEPO-R and TAP. Development efforts to improve the STEPO system designs continue, and physiological evaluation of new developmental models is underway. GRA

N90-17314# Technische Univ., Berlin (Germany, F.R.). Bereich Flugfuehrung und Luftverkehr.
CHECKLIST READING PROBLEMS IN AIRPLANES EQUIPPED WITH SPEECH RECOGNITION SYSTEMS [ZUR PROBLEMATIK DES CHECKLISTENLESENS IN VERKEHRSFLUGZEUGEN UNTER ZUHILFENAHME VON SPRACHMODULEN]
HEINRICH MENSEN and THILO LIEBIG Jul. 1989 125 p In GERMAN
(ILR-MITT-223(1989); ETN-90-96181) Avail: NTIS HC A06/MF A01

The use of speech recognition systems to help pilots control and keep track of ever more complicated flight management systems is outlined. A hydraulic system leak or loss checklist is used as a model of interactions of pilot and computer via a speech recognition system. Details of the computer control system used and the pilot/computer interface are outlined. Simulation of an emergency hydraulic leak situation is presented to illustrate the practical parameters involved in such a system. ESA

N90-17315# Oak Ridge National Lab., TN. Center for Engineering Systems Advanced Research.
JOB PLANNING AND EXECUTION MONITORING FOR A HUMAN-ROBOT SYMBIOTIC SYSTEM
LYNNE E. PARKER Nov. 1989 32 p
(Contract DE-AC05-84OR-21400)
(DE90-004464; ORNL/TM-11308; CESAR-89/34) Avail: NTIS HC A03/MF A01

The human-robot symbiosis concept has the fundamental objective of bridging the gap between fully human-controlled and fully autonomous systems to achieve true human-robot cooperative control and intelligence. Such a system would allow improved speed, accuracy, and efficiency of task execution, while retaining the human in the loop for innovative reasoning and decision-making. Earlier research has resulted in the development of a robotic system architecture facilitating the symbiotic integration of teleoperative and automated modes of task execution. This architecture reflects a unique blend of many disciplines of artificial intelligence into a working system, including job or mission planning, dynamic task allocation, human-robot communication, automated monitoring, and machine learning. This report focuses on two elements of this architecture: the Job Planner and the Automated Monitor. DOE

N90-17614# Air Transport Users Committee, London (England). Air Transport Users Committee.
SMOKEHOODS DONNED QUICKLY. THE IMPACT OF DONNING SMOKEHOODS ON EVACUATION TIMES
J. H. B. VAN *In* AGARD, Aircraft Fire Safety 12 p Oct. 1989
Copyright Avail: NTIS HC A18/MF A03; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

Seven hundred and sixty-five volunteers aged between 18 and 50 took part in 9 simulated emergency evacuations in clear air and smoke with and without ventilated smoke hoods. Analysis of differences between the experimental conditions, age, sex, seat location, exit, and test run showed that the key factor was seat location. While the wearing of hoods and the presence of smoke both increased the evacuation times the interaction between these separate factors was negative, indicating that the use of hoods in the presence of smoke was less than the sum of the additional times attributable to smoke and hood. A quadratic response surface model enabled the evacuation time for each seat to be predicted for each condition and show that evacuation time increases with the distance from an exit and the aisle. It was concluded that the wearing of smoke hoods should not significantly impede the ability of passengers to evacuate an aircraft cabin in an emergency. Author

N90-17616# Civil Aeromedical Inst., Oklahoma City, OK. Protection and Survival Lab.
THE RESEARCH PROGRAM AT THE CIVIL AEROMEDICAL INSTITUTE CONCERNING PROTECTIVE BREATHING EQUIPMENT FOR USE BY CREW AND PASSENGERS IN AN AVIATION SMOKE/FUME ENVIRONMENT
E. ARNOLD HIGGINS *In* AGARD, Aircraft Fire Safety 7 p Oct. 1989
Copyright Avail: NTIS HC A18/MF A03; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

On June 3, 1987, a final rule defining Crew Protective Breathing Equipment (CPBE) was issued by the FAA. On September 1, 1987, Action Notice A-8150.2 (Guidelines for Approval of Crewmember Protective Breathing Equipment) established requirements and tests for certifying CPBE. The recommended method for testing contaminant leakage proved unsatisfactory when

chemically-generated oxygen was used. The Civil Aeromedical Institute (CAMI) developed a new method, and has tested two candidate devices. This test method is discussed. Recent interest in reviewing the feasibility of providing passenger protective breathing equipment (PPBE) was stimulated, in part, by the British Airtours B0737 accident at Manchester, England, in August 1985. In October, 1986, the airworthiness authorities at Great Britain, France, Canada, and the United States initiated a coordinated effort to reevaluate PPBE. A history of CAMI involvement in the study of PPBE will be presented, as will the status of current activities in this program. Author

N90-18147*# North Carolina State Univ., Raleigh.
REGULATION OF NITROGEN UPTAKE AND ASSIMILATION: EFFECTS OF NITROGEN SOURCE, ROOT-ZONE PH, AND AERIAL CO2 CONCENTRATION ON GROWTH AND PRODUCTIVITY OF SOYBEANS
C. D. RAPER and L. TOLLEY-HENRY Dec. 1989 71 p
(Contract NCC2-101)
(NASA-CR-177546; NAS 1.26:177546) Avail: NTIS HC A04/MF A01 CSCL 06/11

An important feature of controlled-environment crop production systems such as those to be used for life support of crews during space exploration is the efficient utilization of nitrogen supplies. Making decisions about the best sources of these supplies requires research into the relationship between nitrogen source and the physiological processes which regulate vegetative and reproductive plant growth. Work done in four areas within this research objective is reported: (1) experiments on the effects of root-zone pH on preferential utilization of NO3(-) versus NH4(+) nitrogen; (2) investigation of processes at the whole-plant level that regulate nitrogen uptake; (3) studies of the effects of atmospheric CO2 and NO3(-) supply on the growth of soybeans; and (4) examination of the role of NO3(-) uptake in enhancement of root respiration. Author

N90-18148# Defence Research Establishment, Ottawa (Ontario). Protective Sciences Div.
SOME PRACTICAL ADVICE ON COLD WEATHER CLOTHING
B. FARNWORTH Aug. 1989 16 p
(AD-A215936; DREO-TN-89-21) Avail: NTIS HC A03/MF A01 CSCL 05/8

Considerable research and development has been carried out on cold weather clothing at the Defense Research Establishment Ottawa. This paper explains in laymen's language, the practical knowledge gained in the course of this work. It deals in turn with the five elements of good winter clothing design, thickness, dryness, wind proofness, whole-body coverage and flexibility. It concludes with explanations of how breathable fabrics, wicking fabrics and aluminized materials work and how practical they are. GRA

N90-18149# Navy Experimental Diving Unit, Panama City, FL.
INSULATION, COMPRESSIBILITY AND ABSORBENCY OF DRY SUIT UNDERGARMENTS Final Report
JOHN A. STERBA, R. SCOTT HANSON, and JOSEPH F. STIGLICH Aug. 1989 26 p
(AD-A215944; NEDU-10-89) Avail: NTIS HC A03/MF A01 CSCL 05/8

Recent selection of new undergarments (U/G) for cold water diving has been based on anecdotal reports. Previous studies revealed hydrophobic microfibrous material (Thinsulate) to be superior in both insulation when wet and compressibility compared to open-cell foam. The objectives of this study included comparing Thinsulate against the new U/G materials in a controlled, unmanned study. After preliminary testing of 39 U/G composites, nine U/G were chosen: four using arctic fleece, radiant barrier and both Thinsulate and polyester battings from Defense Marketing Consultants (DMC), four using Thinsulate M-400 and M-600 from Diving Unlimited International (DUI) and the Flectalon U/G composite from Arktis Outdoor Products. Dry U/G per unit thickness showed few differences. Saturated with water, the superior U/G, per se, were Flectalon, DUI M-600 and one DMC U/G using Dupont Dacron-II batting. The superior wet U/G, per unit thickness, included the above and M-400 DUI U/G. In conclusion, rating compressibility, absorbency and insulation (wet), the superior U/G included Flectalon and DUI U/G, M-400 and M-600 weights. DMC U/G were ranked next, primarily due to high absorbency. The DMC radiant barrier did not significantly affect insulation by contributing any reflected radiant energy based upon the small temperature gradient between skin and water. GRA

N90-18150# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
PARETO OPTIMIZATION DESIGN TECHNIQUES FOR THE AFIT (AIR FORCE INSTITUTE OF TECHNOLOGY)/AAMRL (ARMSTRONG AERONAUTICAL MEDICAL RESEARCH LABORATORY) ANTHROPOMORPHIC ROBOTIC MANIPULATOR M.S. Thesis
JERREL D. TUMLIN, JR. Dec. 1989 161 p
(AD-A216178; AFIT/GCS/ENC/89D-3) Avail: NTIS HC A08/MF A01 CSCL 12/9

A method to optimize a robotic parallel manipulator configuration using Pareto Optimization techniques was developed. Pareto optimization is a cooperative effort between design parameters. The design parameters to be optimized included the payload mass, the length of the manipulator link labelled 12, and the prescribed time for the manipulator to move a prescribed distance. Three functionals were computed for design optimization. These included the mechanical efficiency of the system, the maximum value of torque for motor one, and the maximum value of torque for motor two. A functional analysis was performed using two trajectories for the manipulator; a horizontal trajectory and a vertical trajectory. A combination of these paths allows the manipulator to reach anywhere within its workspace. Algorithms were developed for computing each of the functionals when changing any of the design parameters. When the horizontal path was traversed, mechanical efficiency was zero, thus total input work of the manipulator was evaluated. The sensitivities of the design parameter changes were evaluated for optimization. When a horizontal path was followed, only the link 1 (2) length had changing sensitivity values. Sensitivity changes occurred for all of the design parameters for a vertical trajectory. GRA

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SPACE BIOLOGY

Includes exobiology; planetary biology; and extraterrestrial life.

A90-25177
THE FLOW OF ENERGY, NATURAL LEARNING SYSTEMS AND THE CREATION OF LIFE ON EARTH
JOHN B. CORLISS Acta Astronautica (ISSN 0094-5765), vol. 19, Nov. 1989, p. 869-873. refs
Copyright

It is hypothesized that the deep sea hot springs which cooled the earth's first ocean crust also furnished the environment for the evolution of self-replicating organic structures into living organisms; a deeper appreciation of the processes at work in hot springs is held to suggest a novel vision of the relationship of all life to the physical universe. Sea-floor hot springs encompass a hierarchy of dissipative structures evolving to higher levels of order, organizing the matter contained within; this matter extends to components necessary for the construction of living organisms. O.C.

A90-26762
INTERSTELLAR AND CIRCUMSTELLAR MOLECULES AND ELEMENTS NECESSARY FOR LIFE [MOLECULES INTERSTELLAIRES ET CIRCUMSTELLAIRES ET ELEMENTS NECESSAIRES A LA VIE]
JEAN-PIERRE LAFON (Paris, Observatoire, Meudon, France)

L'Astronomie (ISSN 0004-6302), vol. 103, Dec. 1989, p. 489-493. In French. refs
Copyright

Organic chemistry in interstellar and circumstellar regions is examined. The theory of the origin and evolution of elements after the big bang is reviewed and the chemical composition of the interstellar medium is described. Consideration is given to chemical reactions in the interstellar medium, in circumstellar envelopes, and on solid condensed matter. Also, the quantum aspects of the formation of complex organic molecules in the interstellar medium or the primordial earth atmosphere are examined. R.B.

A90-26766
THE FORMATION OF THE BUILDING BLOCKS OF LIFE ON THE PRIMORDIAL EARTH [FORMATION DES BRIQUES DU VIVANT SUR LA TERRE PRIMITIVE]
F. RAULIN (Paris XII, Universite, Creteil, France) and J. C. GUILLEMIN (Rennes I, Universite, France) L'Astronomie (ISSN 0004-6302), vol. 103, Dec. 1989, p. 509-514. In French. refs
Copyright

Studies concerning the early stages of biochemical evolution on earth are reviewed, focusing on the formation of small reactive organic molecules in the atmosphere and the evolution of these molecules in water to form biochemical monomers. Consideration is given to global simulations of the formation of amino acids from inorganic matter and studies on the formation of small organic molecules such as HCN and HCHO in the gas phase. Also, experiments on the prebiotic synthesis of biological monomers and polymers in water are discussed. R.B.

A90-26767
THE EARLY EMERGENCE OF PROTEINS [EMERGENCE PRECOCE DES PROTEINES]
ANDRE BRACK and BERNARD BARBIER (CNRS, Centre de Biophysique Moleculaire, Orleans, France) L'Astronomie (ISSN 0004-6302), vol. 103, Dec. 1989, p. 515-518. In French. refs
Copyright

The emergence of proteins on the primordial earth is examined. Laboratory experiments on the selective polymerization of particular amino acids in the primordial soup are discussed. Consideration is given to the role of protein conformation stability in the amino acid selection process. Also, the chemical behavior of peptide microstructures and the catalytic properties of peptides and simple polypeptides are discussed. R.B.

A90-26768
NUCLEIC ACIDS AND THE ORIGINS OF LIFE [ACIDES NUCLEIQUES ET ORIGINES DE LA VIE]
MARIE-CHRISTINE MAUREL (CNRS, Institut Jacques Monod, Paris, France) L'Astronomie (ISSN 0004-6302), vol. 103, Dec. 1989, p. 519-525. In French. refs
Copyright

Theories concerning the prebiotic synthesis of nucleic acids are reviewed. Consideration is given to the possible environments for the origins of nucleic acids, including the primordial soup, quasi-crystalline clays, and surface metabolites. The possible conditions for the replication of RNA in the absence of enzymes are studied. The possibility that purines are the precursors to life is examined, noting the chemical behavior of the reactive imidazole group. Also, the possible role of the catalytic activity of RNA in the origin of life is discussed. R.B.

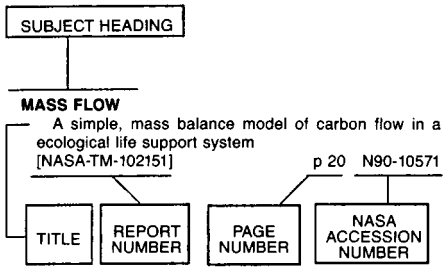
A90-26769
CHIRAL MOLECULES AT THE ORIGIN OF LIFE [LES MOLECULES CHIRALES AUX ORIGINES DE LA VIE]
GERARD SPACH (CNRS, Rouen, France) L'Astronomie (ISSN 0004-6302), vol. 103, Dec. 1989, p. 527-530. In French.
Copyright

The relationship between chiral molecules and the origin of life is examined. The chemical and optical characteristics of chiral molecules are summarized and theories concerning the origin of chirality and the stereospecificity of amino acids and nucleotides are reviewed. A model for the origin of the optical activity of living organisms is proposed, in which selective permeation of a barrier membrane composed of amphiphilic homochiral molecules is responsible for the selection of right-handed or left-handed entantiomers. R.B.

N90-17316*# National Aeronautics and Space Administration, Washington, DC.
PUBLICATIONS OF THE EXOBIOLOGY PROGRAM FOR 1988: A SPECIAL BIBLIOGRAPHY
Feb. 1990 53 p Prepared in cooperation with George Washington Univ., Washington, DC
(NASA-TM-4169; NAS 1.15:4169) Avail: NTIS HC A04/MF A01 CSCL 06/2

The 1988 publications resulting from research pursued under the auspices of NASA's Exobiology Program are listed. The Exobiology Program is an integrated program designed to investigate those processes that may have been responsible for or related to the origin, evolution, and distribution of life in the universe. Research supported by this program is in the areas of cosmic evolution of biogenic compounds, prebiotic evolution, early evolution of life, and evolution of advanced life. Pre-mission and pre-project activities supporting these areas are included in the areas of solar system exploration and the search for extraterrestrial intelligence. A planetary protection subject area is also included because of its direct relevance to the Exobiology program.
Author

Typical Subject Index Listing



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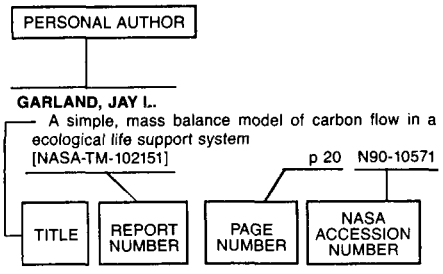
PERSONAL AUTHOR INDEX

Typical Personal Author Index Listing



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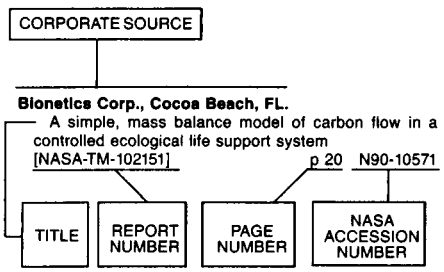

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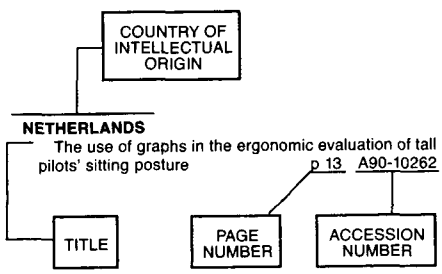

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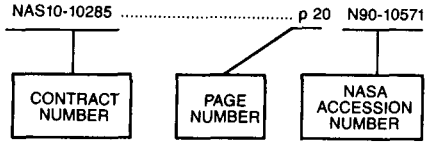

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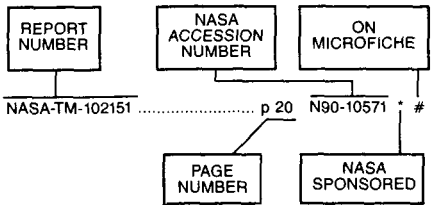

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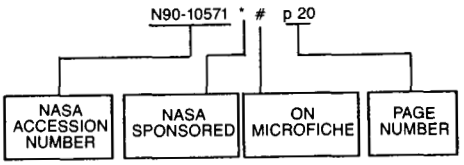

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